RAILWAY ENGINEERING AND MAINTENANCE OF WAY.

BRIDGES - BUILDINGS - CONTRACTING - SIGNALING - TRACK

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WITH WHICH IS INCORPORATED ROADMASTER AND FOREMAN

BRIDGES—BUILDINGS—CONTRACTING—SIGNALING—TRACK

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CONTENTS.

Operating Department's Supervision of Maintenance.

A PECULIAR organization is in effect on a few railways in which the maintenance forces are under the supervision of the superintendents, operating department officials, and not the maintenance of way engineers. Needless to say, this organization is productive of many misunderstandings, jealousies and mistakes. Operating officials with a few notable exceptions, are neither civil engineers nor track men. The only experience these men have had in track work has been gained from riding over the line, or possibly a few points picked up when handling work trains on construction and maintenance.

The idea of having the central authority invested in one man for all men on one division, we believe to be good. This man, however, should be a man of the widest experience and ability. And he should have one or two assistants with special knowledge in the different departments. Such an organization would tend to cause less friction, larger and quicker concentration of forces in times of emergency, and less duplication of work.

It is extremely hard to work for any man who does not know his business. It is hard to find a less popular person than the inexperienced man who holds his position through favoritism. The same holds true with respect to any man in charge of portions of work in which he is inexperienced, and has not the advice of a competent assistant.

We are glad to note recently, a tendency to promote the officials of almost any department into the higher positions of the operating department. The especially capable men from the engineering or mechanical departments are having the higher offices opened to them through this procedure. There are some men broad minded enough to treat all departments squarely, giving the department from which they came no preference. Such a man has obtained, through study, keen observation and long experience, much knowledge of other departments. A harmful effect of the system mentioned above (maintenance under the charge of superintendents) is that it usually results in antagonism between the construction and maintenance forces.

On a large trunk line entering Chicago, some third and fourth track was being built by the engineering department. The operating officials showed their jealousy by criticising the progress of the work, and finally the superintendent was able to persuade the general manager (who had always been in the operating department) that his forces were in a position to do the work much more efficiently. The work was taken away from the engineering department. If any greater progress was made it was due to the fact that every facility was provided for getting and retaining laborers. And also because the trainmen quit "bucking" those in charge of the work, an item of no small importance under the former regime.

To see the folly of the above procedure, one has only to look out the car windows on the railway in question. For several miles there are unconnected stretches of third and fourth track, laid from street to street. These tracks are partially and in some places entirely buried from the accumulated dirt and cinders of seven years.

These short stretches of track had not been projected by

the engineering department. They were put in without plans or stakes. And when it was too late, these tracks were found to conflict seriously with grade separation plans; to connect the tracks through would have meant moving many stations which were to be torn down and destroyed when grade separation commenced. In addition to this the plans of the railway included a cut-off for freight which practically relieved that section of road from all except local freight movements.

This case illustrates the unwisdom of carrying out any small job, especially in a thickly populated district, without considering carefully its relation to general comprehensive plans. And such plans are to be obtained and are known in detail only by the engineering officials.

Increasing Responsibility of Employees Without Corresponding Increase in Salary.

SLIGHTING competent men when making promotions has already been touched upon in these columns. There is another evil which deserves mention in connection with the subject, and that is giving a man charge of work, or raising the grade of work he performs, and failing to raise his wages correspondingly. Usually in a case of this kind the correct title is withheld from the man in the new position.

This policy is sometimes carried out by a department head because he figures that it makes a good showing for himself. On the other hand it is frequently made necessary by the attitude of the officers in final charge of the apportionment of payroll allowances.

We have noted a good many of these instances, a few of which follow: A man, with the nominal title of instrumentman, was placed in full charge of a construction job, without changing his title or increasing his wages; a man with the nominal title of rodman was given an instrument, without corresponding wage increase; a foreman was given the work of an assistant roadmaster without the title or remuneration. These examples occur up nearly to the head of the department.

A department head should be severely condemned if, knowingly and for selfish ends, he refuses his subordinates proper titles and deserved wages when they are promoted, or given the responsibilities of a position which implies a promotion. His argument before his superiors will be that he is getting his work done with an inferior and low-paid organization through his own superior ability. Such a man will not have the respect of his subordinates and they will take advantage of him whenever possible, because *he* takes advantage of *them*. And his superior officers will some day come to know his unfairness and lose their respect for him.

Where a similar policy is necessitated by the financial condition of the railway, the matter is not easily adjusted, except by just and equitable treatment to all concerned, offering the greatest opportunity possible to each company man to attain higher positions, and not appointing outsiders, except when necessary. And in a department which has a skilled organizer at its head, it is practically never necessary to call in outsiders for high positions, unless the demand suddenly becomes great for a number of men.

TERMINAL WORK AT CUMBERLAND, B. & O. R. R.

Owing to the large increase in freight business at Cumberland, the Baltimore and Ohio R. R. has arranged to construct a freight house and team tracks at this point. The freight house will be 37 feet wide by 150 feet in length, with platform extensions at both ends. The building will have concrete foundations, steel or concrete frame, with rolling steel frame doors and slate roof, and will be equipped to take care of the increased freight business for a number of years to come.

Contract for this improvement has been awarded to P. Farrell, of Cincinnati and it will cost approximately $50,000.

New engine terminals will also be built at Cumberland, and the railroad company has arranged to construct a new engine house consisting of 31 stalls. In addition to the engine-house there will be a power house 65 feet by 65 feet with a radial brick stack, 150 feet high. There will also be a machine shop 70 feet in width by 142 feet in length. These three buildings will be constructed of brick and steel. A cinder pit, 150 feet long, will be built to accommodate engines on two tracks. There will be a reinforced concrete mechanical coaling-station, with a storage capacity of 600 tons of coal so that an engine can be coaled from any one of four tracks. There will also be a frame sand house with a capacity of 300 tons of wet sand and 100 tons of dry sand. There will be two concrete inspection pits, 30 feet in length, as well as a new tank sewer with numerous branches furnishing a new water supply system. The total cost of the engine terminals will approximate $500,000. Plans and specifications for both improvements were prepared by M. A. Long, architect of the road.

CASCADE TUNNEL, C., M. & P. S. RY.

L. B. Rowland.

At the rate of 250 feet a month the Chicago, Milwaukee & Puget Sound railroad is driving the two-and-a-quarter-mile tunnel through the Cascade mountains in Washington which will shorten its transcontinental route four and a half miles and get rid of seven miles of heavy grade and curves.

The tunnel begins at Rockdale, four miles west of the highest point on the present track over the Cascades, and will emerge nearly four miles east of the summit. It will replace with a grade of four-tenths per cent on an absolutely straight line, a stretch of seven miles on a grade of two and one-half per cent with maximum 10-degree curves.

The tunnel is being drilled with a heading 16 feet wide and 12 feet high, which is timbered before tracks are laid for hauling the rock, trapped out to the full height of 24 feet. One hundred and twenty men are working in six-hour shifts, doing six hours on and 12 hours off. Four steam and compressed air drills are used continuously.

The present tracks over the summit will be maintained, but will be used only in case of an accident in the tunnel or for routing passenger trains to give travelers the benefit of the scenic beauty of Snoqualie pass. A plan of the present route, with the line of the tunnel given, would show the tunnel as the base of an isosceles triangle, of which each side would be nearly twice as long as the base. The tunnel will be 11,842 feet long and will be completed in time to handle the traffic in 1915.

Locomotive Fuel Consumption and the Speed Diagram

Effect of Gradient, Alignment, Operating and Other Conditions, on Locomotive Fuel Consumption

By A. K. Shurtleff, Office Engr., C., R. I. & P. Ry.

The largest primary account in the operating cost of the average railroad is "Fuel for road locomotives." Locomotive fuel consumption can be divided as follows:

1. Fuel used for work.
2. Fuel used account of leakage of water and steam, and for steam used for brakes, whistling, etc.
3. Fuel used for re-evaporation due to radiation.
4. Fuel used at engine houses "firing up," etc.

The tables in the American Railway Engineering Association Manual of 1911 provide for fuel used under the first three headings during the period of maximum effort.

Two tons of coal per hour is the average that can be properly hand-fired by a single fireman in a modern freight locomotive, through the long periods of maintained effort required in making the schedule with the maximum train. The tables referred to, however, provide for any practical amount of fuel consumption, but it is rare even with a relief fireman that over five thousand pounds of coal per hour will be fired during the period of maximum work by a freight locomotive.

No accurate mathematical method can be fixed for estimating locomotive fuel consumption. Details of construction, condition of the locomotive and the "personal equation" of both the engineer and fireman introduce variables which materially affect the question. Single tests may show what might be expected under like conditions, but for the student of economics in railway location or operation, averages must be considered. The personal equation of the fireman probably is the greatest variable, and for the same man will vary widely on different trips.

No economic study can be of value that does not consider the average efficiency of the laborer.

The fuel used by locomotives while drifting or at rest is a material amount of the total consumption. At the 1904 convention of the American Master Mechanics' Association, some valuable data was presented covering twenty-one tests over an engine district on the Atchison, Topeka & Santa Fe, and twenty-four tests on the Norfolk & Western.

From this data the accompanying tables covering fuel used at rest was obtained. The tables are arranged in the order of delayed time for each locomotive and a study of the coal used as compared with the time delayed will show the variable character of the personal equation and the necessity of following the rule of averages in estimating economies.

A., T. & S. F. Test Trains. Test Trip 112.74 Miles.
Coal 11,000 B. T. U.

Loc. No.	Sq. Ft. H.S.	Delays Hrs.Min.	—Used at Delays— Lbs. Coal	Lbs. Water
606	2,626	1:17	735	1,865
606	2,626	1:20	377	3,000
606	2,626	1:52	1,086	1,487
606	2,626	3:05	1,800	1,991
606	2,626	3:52	1,186	1,159
601	2,626	2:08	585	2,053
601	2,626	2:44	1,110	2,525
601	2,626	3:42	1,290	2,458
601	2,626	3:55	1,260	3,981
601	2,626	5:42	1,590	1,604
1051	3,738	1:03	615	1,195
1051	3,738	1:05	660	3,767
1051	3,738	1:11	1,020	1,393
1051	3,738	1:35	770	1,758
1051	3,738	3:25	1,255	1,254
565	3,666	3:15	1,155	2,293
175	1,560	1:06	490	1,027
175	1,560	1:17	260	1,022
175	1,560	2:25	980	731
175	1,560	2:44	610	889
175	1,560	3:19	650	2,031
Totals	56,416	52:02	19,484	39,483

Average heating surface per test trip..... 2,686 sq. ft.
Coal used per hour delay, total..... 374.5 lbs.
Per 1,000 ft. H.S..... 139.4 lbs.
Water used per hour delay, total..... 758.8 lbs.
Per 1,000 ft. H.S..... 282 lbs.

Coal used per trip "firing up" at engine houses, average of 15 tests.....515 lbs. per 1,000 sq. ft. H. S.

N. & W. Test Trains. Test Trip 99.7 Miles.
Coal 14,000 B. T. U.

Loc. No.	Sq. Ft. H.S.	Delays Hrs.Min.	Coal Used at Delays
923	2,474	1:43	1,400
923	2,474	2:36	500
923	2,474	2:36	925
923	2,474	2:40	1,800
923	2,474	4:14	800
923	2,474	4:38	1,000
923	2,474	5:20	700
923	2,474	6:23	2,000
923	2,474	8:37	600
923	2,474	8:48	2,300
923	2,474	10:23	1,838
923	2,474	12:42	3,800
839	2,415	1:29	1,175
839	2,415	1:55	300
839	2,415	2:15	400
839	2,415	2:23	500
839	2,415	2:44	900
839	2,415	3:20	300
839	2,415	3:53	800
839	2,415	4:41	600
839	2,415	5:00	1,000
839	2,415	5:41	1,000
839	2,415	5:47	900
839	2,415	6:00	1,300
Totals	58,668	115:48	26,838

Average heating surface per test trip..... 2,445 sq. ft.
Coal used per hour delay, total..... 232 lbs.
Per 1,000 ft. H.S..... 94.8 lbs.

Coal used per trip firing up at engine houses, average, 24 tests.....501 lbs. per 1,000 sq. ft. H. S.

The fuel loss by radiation depends on the temperature of outside atmosphere, area of boiler exposed and quantity and quality of boiler covering. The exposed area varies and is not one of the items given with locomotive dimensions. With modern locomotives there is from 4.75 to 5.75 square feet of exposed area to one square foot of heating surface. The proportion of this outside area insulated against transmission of heat varies. Evaporation is from heating surface, and owing to the variables and undetermined area of boilers exposed, the losses will be based on heating surface.

The heat loss from radiation is the total loss when locomotive is not working less the loss due to leakage and use of steam and water for other purpose than work.

In the A., T. & S. F. tests, it would require 34.7 pounds of 11,000 B. T. U. coal per 1,000 square feet of H.S. to evaporate the 282 pounds of water used per hour while idle from a feed water temperature of 65 degrees to a boiler pressure of 200 pounds.

The N. & W. tests do not give the water and steam losses while at rest. In 97 tests at the St. Louis Exposition testing plant the average steam loss per hour per 1,000 square feet of heating surface was 151 pounds. These locomotives were probably in as good or better condition than the average road locomotive and the N. & W. locomotives can be considered as losing at least this amount of water and steam.

There would be required 14.6 pounds of 14,000 B. T. U. coal per 1,000 square feet H.S. to evaporate this quantity of water wasted.

A fair average for this loss of heat due to other uses of steam and leakage can be based on 200 pounds loss an hour per 1,000 square feet of heating surface.

The coal loss from radiation during delays in these tests can then be estimated as follows:

A., T. & S. F.: 139.4 — 34.7 = 104.7 lbs. per 1,000 ft. H.S.

N. & W.: 94.8 — 14.6 = 80.2 lbs. per 1,000 ft. H.S.

Mr. Henderson, in "Locomotive Operation," states that in tests with one locomotive he found the loss from radiation at 28 M. P. H. velocity double the loss with locomotive standing.

Practically all drifting is done on gradients, and at a velocity exceeding this; therefore no great error will occur in basing this loss while drifting at double the amount standing.

The fuel used in the tests at engine houses firing up does not seem consistent with the total heat units when comparing the two series of tests. This is due to many causes. Engine-house practice varies widely on different roads and in the houses of the same road. Probably the least study in reduction of fuel wastes is given to fuel used while the engines are at terminals.

The following table is arranged, based on results secured in these tests and the assumption that evaporation is proportional to the total heat units in the coal, except in the case of coal "firing up," which, until better methods obtain, is based on the amount actually used in the tests. In proportioning the fuel on the B. T. U. contained, the fact that ash and other components of the fuel vary must be neglected along with the other variables.

Approximate Pounds Coal Burned per 1,000 Sq. Ft. Heating Surface, Locomotive Not Working.

B. T. U. Per Lb. Coal	Per Trip Firing Up	Radiation, Leakage, Etc. Per Hour	
		Standing	Drifting
10,000	520	145	263
11,000	515	132	239
12,000	510	121	219
13,000	505	111	202
14,000	500	103	188
15,000	495	97	175

As a test of the value of the above table in approximating fuel consumption the following data is given covering one week's actual operation on a division of three engine districts. The data given is actual except that time drifting is estimated by platting a "time diagram," and this deducted from actual running time to get time "working."

Total freight locomotive miles		27,575
Total freight locomotive trips		220
Heating surface per locomotive		2,905
Hours delay (standing)		855.4
Hours drifting	408.2	
Hours working	1,312.6	
Total hours running time		1,720.8

Average value of coal, 11,000 B. T. U.

Estimated Fuel Used.

	Pounds
Firing up, 220 trips @ 1,496 lbs	329,120
Standing, 855.4 hours @ 383.46	328,012
Drifting, 408.2 hours @ 694.3	283,413
Working, 1,312.6 hours @ 4,000	5,250,400
Total estimate	6,190,945

Estimate per freight locomotive mile, 224.5 lbs.

The actual cost used per freight locomotive mile on this division during the month from which this data was taken was 224.1 pounds. It cannot be expected that as close an approximation can be obtained in all cases, but this method can be applied to different locations or different divisions and a reasonable comparison made of the relative fuel economy, providing the data to estimate the same is at hand.

The table covering the fuel used is of little value except as information to the student of economics unless a method be provided for estimating the various components of the total time over a district. From data secured on two western roads, single track divisions, and covering two weeks' time on seven engine districts of one line and one week's time on three engine districts of the other, the average time taken for orders, coaling and watering locomotives was one-half minute per engine per mile of district. The total number of meeting points and points of passing by superior trains was 8,709, and the average time delay for each freight train was 15.9 minutes for each of such points. On the lighter traffic districts where time was ample, more time was taken than above at meeting or passing points.

A safe figure for estimating the delay time is ½ minute per engine mile plus 15 minutes for each train met or train in same direction allowed to pass.

The number of such points can be closely approximated by estimating the number of freight trains required to handle a given traffic, both freight and passenger, and platting the same graphically on a chart similar to those used in making time cards, one side drawn to scale of miles over locomotive district; the other into scale of 24 hours. Where information is not available as to the time trains may reach the district, the total number of trains may be spaced out through the 24 hours. The trains in one direction may be platted in straight lines covering the district in the time of the *desired* schedule. The passenger trains and one freight train in the opposite direction may then be platted and the intersections of the one freight with other trains counted.

With this method, lines representing schedules for the different classes of freight service may be used and the points determined for each class.

The foregoing method refers to single track. On double track only trains in the direction of traffic should be considered.

Running time, divided between time working and drifting, may be estimated by the construction of a time diagram.

The method requires labor, but after preparing the tables suitable for the problems it is possible to plat the speed lines and calculate the time over fifty miles or more of profile per day. The problem in economics of railway operation or location is not solved until reasonable proof has been obtained that the assumed train can move over the district within the allotted time, and on a district with adverse grade, most of which may be controlling and practically all in one direction, or on districts of a very low rate of gradient, the locomotive must be operating at a shortened cutoff to get over the district without overtime. The time taken in the preparation of a set of tables is well spent, and the tables are valuable for many different problems. The time diagram will frequently save the engineer severe criticism and, of far greater importance, will save the railways money in preventing expenditures for improvements that are based on incorrect assumptions.

The Speed Diagram and Its Uses.

The preparation of the data necessary to construct a speed diagram requires, first, that a given locomotive be considered, preferably of modern type, and of good power; second, total weight per car of train be approximately known.

For the purpose of illustrating the methods used in the preparation of data the following locomotive is considered.

Type, 2-8-0; cylinders, 22x30 ins.; drivers, 63 ins.; heating surface, 3,300 sq. ft.; boiler pressure, 200 lbs.; weight (including tender), 173 tons.

Using the methods outlined by the 1911 Manual of the Railway Engineering Association, and considering 4,000

pounds of coal with thermal value of 11,000 B. T. U. as the maximum per hour for maintained effort, this locomotive can supply steam for full cut-off up to a velocity of 5 miles per hour, with a cylinder tractive power at this velocity of 39,000 pounds. The locomotive resistance, excluding head end resistance, will be 2,360 pounds.

This locomotive is a fair average of the modern consolidation type used on nearly all roads of any considerable traffic and the calculated maximum velocity at full cut-off is very close to what is being obtained with simple engines in the large territory in which the available fuel approximates a thermal value of 11,000 B. T. U. per pound. This locomotive burning a higher grade fuel would be able to generate steam to fill the cylinders at full cut-off at a greater velocity than given and the calculations necessary for a speed diagram would produce different results, from the tables presented with this paper, but the methods involved in the calculations would be the same.

TABLE NO. 1

LOCOMOTIVE LOADED WITH MAXIMUM TRAIN IT CAN HAUL ON 1% GRADE AT 5 MILES PER HOUR MAINTAINED SPEED
CARS AND CONTENTS, 1306 TONS, LOCOMOTIVE 175 TONS, TRAIN RESISTANCE, 5.4 LBS.
PER TON FOR VELOCITY 4 MILES TO 35 MILES PER HOUR

VELOCITY MILES PER HOUR	LEVEL		GRADE	
	DRAW BAR PULL "P"	TRAIN RESISTANCE "R"	P-R POUNDS	P-R PER TON
START	38980	16978	22002	14.88
1	38512	11734	26758	18.09
2	38043	9142	28901	19.54
3	37574	7836	29738	20.11
4	37104	7052	30052	20.32
5	36634	7052	29582	20.00
6	33328	7052	26276	17.77
7	30567	7052	23515	15.90
8	28259	7052	21207	14.34
9	26324	7052	19272	13.03
10	24669	7052	17617	11.91
11	23221	7052	16169	10.93
12	21870	7052	14818	10.02
13	20577	7052	13525	9.14
14	19345	7052	12293	8.31
15	18168	7052	11116	7.52
16	17041	7052	9989	6.75
17	15992	7052	8940	6.04
18	14985	7052	7933	5.36
19	14082	7052	7030	4.75
20	13179	7052	6127	4.14
21	12334	7052	5282	3.57
22	11561	7052	4509	3.05
23	10869	7052	3817	2.58
24	10197	7052	3145	2.13
25	9617	7052	2565	1.73
26	9074	7052	2022	1.37
27	8565	7052	1513	1.02
28	8103	7052	1051	.71
29	7687	7052	635	.43
30	7298	7052	246	.17
30.67	7052	7052	0	0
31	6932	7052	- 120	-.08
32	6584	7052	- 468	-.32
33	6256	7052	- 796	-.54
34	5954	7052	-1098	-.74
35	5672	7052	-1380	-.93

P= Draw bar pull of locomotive in pounds.
R= Train resistance in pounds.
V_1= Terminal velocity in miles per hour.
V_2= Initial velocity in miles per hour.
(P-R) per ton of train (including locomotive) when positive in value is the net power available for use in overcoming grade resistance at maintained speed. Also represents the power available for acceleration.
(P-R) per ton of train (including locomotive) when negative is the assistance that must be received from descending grades in order to maintain the given velocity. When such assistance is not received it becomes a retarding resistance.
For (P-R) for other than level grades subtract from its value per ton of train for level grades the grade resistance in pounds per ton of train.
The distance in feet required to accelerate from a given velocity to another equals $70(V_1^2-V_2^2)$ divided by the mean of (P-R) per ton of train for the two velocities.

Variables enter into the question of train resistance as a careful reading of the text of the Economics Committee report in part 1, volume 2 of the A. R. E. A. proceedings will disclose and as any engineer can testify who has tried to analyze dynamometer records of two districts of widely different character with reference to curvature and character of maintenance of both roadway and equipment. The modern formulae generally adopted for practical purposes consider the resistance per car on level grade as A + B T. in which A and B are constants and T is tons weight of car and contents. The formula given in the 1911 Manual is a compromise between resistance as found on lines of short tangents, large percentage of curvature and gondola cars and that found on lines of very moderate curvature with the bulk of trains composed of box cars. It is probably too high for prairie lines of fair maintenance, as a careful analysis of twelve test trains maintaining uniform speed for considerable distances on tangent and uniform grade, shows an average of several readings not varying far from the formula of "R" per car = 86 + 2.6 T for level grades. No criticism is intended of the formula adopted by the Association, the present idea being to show the variable character of resistance, and that the formula as adopted may be high for some cases and low in others. The running time of a maximum train of empties between the terminals of a district is necessarily greater than required for a train of maximum loads. The reason for this can readily be understood by considering the difference in resistance due to grades for both trains. Any formula that considers the loading of cars will illustrate the point, but in the following the A. R. E. A. formula is used:

Weight of car.....	20 tons	70 tons
Resistance 1% grade.....	565.6 pounds	1,675.6 pounds
Resistance level grade.....	165.6 pounds	275.6 pounds
Per cent "R" on level.....	29.3%	16.5%

Briefly stated, the proportional resistance on the flatter grades for light loads is much greater than for heavier loading and on these flatter grades the train with the concentrated loading can accelerate to and maintain a higher velocity.

The average running time can be estimated by using a figure for resistance that will approximately agree with the average weight per car of train. In the following calcula-

tions 5.4 pounds per ton level resistance is assumed. This would represent an average weight per car of 30.7 tons, according to the formula $R = 86 + 2.6\ T$; 32 tons by the Pennsylvania formula, and 38 tons by the A. R. E. A. formula. The average weight per car of the leading roads of the country varies between 30 and 40 tons.

Tables Nos. 1 to 5 were originally constructed for use on districts having ruling grades from 0.7% to 1%, although they may be used with a considerable degree of accuracy for lighter gradients. The method of using them will be explained later.

Table No. 1, "Locomotive loaded with maximum train for 1% grade," is figured on the maximum at 5 miles per hour. Formerly in calculations of this character 10 miles per hour was the minimum velocity assumed, but common practice in every-day work for dead freight will load the locomotive down to this low velocity on the ruling grades wherever there is sufficient amount of lighter gradients on the district so that the train can cover the same without overtime, unless the traffic be so dense as to call for the stopping and starting of trains on the ruling gradients due to block signals being against them.

This table gives the draw bar power of locomotive from starting up to 35 miles per hour on level grade, the train resistance, and the difference between the two. The difference in resistance represents the power that can be used in accelerating or retarding trains on level grade or in overcoming gradient as explained in the notes on the table.

Tables Nos. 2 and 3 covering distances in stations and decimals passed in accelerating or retarding with locomotive working, are calculated from the formula given on Table No. 1. The distances given for acceleration to each velocity are the sums of the various increments in accelerating from mile to mile, velocities from the starting point, or in case of the heavier grades, from the lowest mile velocity at which a train can be moved. In retarding grades the distances are from an initial velocity of 35 M. P. H. The distance passed over in going from one velocity to another is the difference between the figures shown on the table for the respective velocities.

Table No. 4 covering distances traveled in drifting is calculated on the same principle except that the resistance of train, locomotive resistance and the mean head end resistance are added together, and divided by total weight of train, including locomotive, to get resistance per ton of train. The difference between this and grade resistance gives the power per ton for accelerating or retarding train. The use of the mean head end resistance, while not mathematically correct, creates only a slight error in the tables as it is only a small part of the resistance, and it simplifies the preparation of the table materially.

Platting the speed line closely for any given profile will show that the line for any one gradient advances in a very flat curve except at starting. For all practical purposes the line can be assumed as advancing in a straight line throughout the length of a single stretch of gradient or to the point

TABLE NO. 2

WEIGHT CARS AND LADING 1306 TONS
WEIGHT LOCOMOTIVE 172 "
TOTAL TRAIN 1478 "

ACCELERATIONS AND RETARDATIONS

LOCOMOTIVE LOADED WITH MAXIMUM TRAIN IT CAN HANDLE ON 1% GRADE AT 5 MILES PER HOUR MAINTAINED SPEED.

ENGINE WORKING STEAM - ASCENDING GRADES.

VELOCITY MILES PER HOUR	0.0 GRADE	+0.1 GRADE	+0.2 GRADE	+0.3 GRADE	+0.4 GRADE	+0.5 GRADE	+0.6 GRADE	+0.7 GRADE	+0.8 GRADE	+0.9 GRADE	+1.0 GRADE
0	.04	.05	.06	.07	.08	.11	.16	.29	WILL NOT START	WILL NOT START	
1	.15	.18	.20	.23	.28	.35	.47	.73	.74	2.56	
2	.33	.39	.43	.50	.60	.71	.92	1.33	1.66	4.48	WILL NOT START
3	.59	.67	.75	.87	1.03	1.19	1.52	2.12	2.82	6.70	23.33
4	.92	1.02	1.16	1.34	1.58	1.81	2.29	3.14	4.33	9.61	62.70
5	1.33	1.48	1.68	1.94	2.29	2.68	3.41	4.72	7.00	59 16.48 / 52 78.32	62.93
6	1.87	2.09	2.39	2.78	3.32	4.01	5.29	7.84	69 16.18 / 62 152.61	71.08	56.05
7	2.56	2.89	3.33	3.93	4.78	6.06	8.66	17.32	85.35	63.30	53.18
8	3.43	3.91	4.56	5.48	6.89	9.29	15.74	43 37.49 / 39 55.02	73.42	59.65	51.03
9	4.50	5.18	6.13	7.53	9.87	14.67	38.86 / 57.48	89.33	68.29	56.90	49.15
10	5.79	6.74	8.11	10.31	14.17	25.02	126.52	80.64	64.52	54.49	47.38
11	7.33	8.64	10.60	13.91	20.69	58.91	101.18	74.94	61.31	52.26	45.67
12	9.16	10.95	13.74	18.80	31.77	161.06	90.66	70.38	58.40	50.12	43.98
13	11.33	13.76	17.74	25.75	57.84	119.39	83.43	66.42	55.67	48.04	42.30
14	13.89	17.19	22.93	36.35	144 71.78 / 94 23.57	104.62	77.67	62.84	53.07	46.00	40.62
15	16.93	21.42	29.86	55.55	151.71	94.88	72.70	59.50	50.56	43.99	38.94
16	20.54	26.67	39.49	113.30	126.62	87.32	68.24	56.34	48.11	41.99	37.25
17	24.84	33.29	53.90	171 115.35 / 129.78	112.18	80.90	64.11	53.30	45.70	40.00	35.55
18	29.96	41.77	78.45	170.16	101.53	75.20	60.22	50.35	43.31	38.01	33.84
19	36.11	52.96	139.80	142.75	92.74	69.96	56.49	47.45	40.94	36.01	32.11
20	43.56	68.47	202 220.29 / 328.81	125.25	85.07	65.05	52.88	44.59	38.58	34.00	30.36
21	52.65	91.45	221.50	111.90	78.15	60.43	49.36	41.76	36.22	31.97	28.58
22	63.82	129.86	177.86	100.71	71.73	55.93	45.90	38.94	33.85	29.92	26.78
23	77.82	222.54	151.08	90.80	65.65	51.54	42.47	36.12	31.46	27.84	24.95
24	95.59	24 376.68 / 286.21	131.14	81.79	59.83	47.24	39.06	33.29	29.05	25.74	23.09
25	118.62	307.27	114.57	73.36	54.18	42.99	35.65	30.45	26.61	23.61	21.19
26	149.54	227.94	100.00	65.34	48.65	38.76	32.23	27.58	24.14	21.44	19.26
27	194.05	181.56	86.75	57.61	43.19	34.54	28.79	24.68	21.63	19.23	17.29
28	264.05	147.64	74.47	50.11	37.79	30.32	25.33	21.75	19.08	16.98	15.28
29	401.75	119.74	62.84	42.76	32.42	26.08	21.84	18.78	16.49	14.69	13.23
30	30 741.99 / 78.45	95.45	51.68	35.50	27.05	21.82	18.31	15.77	13.86	12.36	11.14
31	457.43	73.61	40.88	28.33	21.68	17.53	14.74	12.71	11.18	9.98	9.00
32	236.93	53.56	30.38	21.22	16.30	13.21	11.13	9.61	8.46	7.56	6.82
33	131.12	34.84	20.11	14.14	10.90	8.85	7.47	6.46	5.69	5.09	4.59
34	57.84	17.07	10.00	7.07	5.47	4.45	3.76	3.26	2.87	2.57	2.32
35											

where speed becomes a maintained velocity, this method increasing slightly the total estimated time. The speed can be estimated from the tables to the nearest tenth of a mile per hour for the end of each stretch of gradient. For intermediate rates of grade not shown on the table, the values can be determined by interpolation. The speed diagram should be marked plainly showing points where drifting begins or ends. As a general proposition, where there is ample time for schedule of train between terminals, the locomotive should be considered as drifting on all the accelerating gradients where the distance in accelerating to the maximum safe velocity is not too great. In these tables 35 miles per hour has been taken as the average maximum safe speed for freight trains. The application of brakes at stops should be considered as time drifting, and frequently the arrangement of grades approaching stops is such that the locomotive can be considered as drifting and retarding with possibly a short final application of brakes. If at any portion of the line the locomotive would require less than its full power to keep the train at its maximum safe velocity or at a fixed rate of speed, for the purpose of estimating, the locomotive should be considered as working at full power for a distance and then drifting so as to produce as nearly the average rate as practicable. In calculating total time working or drifting the total area lying between the speed and base lines can be estimated for each, the mean velocity for each obtained and with distance known, the time for each calculated. A second method is to calculate the time for each stretch of grade to the nearest hundredth part of a minute, using the mean speed as a divisor. In this method a table of feet per minute for miles and tenths of miles per hour is a convenience particularly where slide rule is used.

Table No. 5 giving grades on which various weight trains can accelerate to and maintain the given velocities, is calculated using the same locomotive and train resistance per ton as for the other tables. The difference between the locomotive draw bar pull at given velocity and train resistance on level grade for the given train divided by the tons weight of train including locomotive gives the grade resistance for the gradient on which the given velocity can be maintained. The formula can be expressed as follows: P = draw bar pull level grade; R = resistance (train) level grade; T = tons train including locomotive; G = per cent gradient for maintained velocity at given speed. Then $G = \frac{P - R}{20\,T}$

The speed diagram platted, and both the time and distance calculated, divided between locomotive working and locomotive drifting, covers only the train for which the tables were calculated. The next step is to determine approximately what time would be required for other weight trains of the same average loading per car. With reference to trains drifting, the time and distance in accelerating or retarding between two given velocities is directly proportional to the

TABLE NO. 3

ACCELERATIONS

WEIGHT CARS AND LADING 1306 TONS
WEIGHT LOCOMOTIVE 173 "
TOTAL TRAIN 1479 "

LOCOMOTIVE LOADED WITH MAXIMUM TRAIN IT CAN HANDLE ON 1% GRADE AT 5 MILES PER HOUR MAINTAINED SPEED.

LOCOMOTIVE WORKING STEAM - DESCENDING GRADES.

VELOCITY MILES PER HOUR	0.0 GRADE	-0.1 GRADE	-0.2 GRADE	-0.3 GRADE	-0.4 GRADE	-0.5 GRADE	-0.6 GRADE	-0.7 GRADE	-0.8 GRADE	-0.9 GRADE	-1.0 GRADE
0											
1	.04	.04	.03	.03	.03	.03	.02	.02	.02	.02	.02
2	.15	.14	.12	.12	.11	.10	.09	.09	.08	.08	.07
3	.33	.31	.28	.26	.24	.22	.20	.19	.18	.17	.16
4	.59	.54	.49	.45	.42	.39	.36	.34	.32	.30	.28
5	.92	.83	.76	.70	.65	.60	.56	.53	.50	.47	.45
6	1.33	1.20	1.10	1.01	.94	.87	.81	.76	.72	.68	.65
7	1.87	1.68	1.54	1.41	1.31	1.21	1.13	1.06	1.00	.94	.90
8	2.56	2.29	2.09	1.90	1.76	1.63	1.52	1.42	1.34	1.26	1.20
9	3.43	3.05	2.76	2.50	2.31	2.13	1.98	1.85	1.74	1.63	1.55
10	4.50	3.97	3.57	3.22	2.96	2.72	2.52	2.35	2.21	2.07	1.96
11	5.79	5.07	4.52	4.06	3.72	3.41	3.15	2.93	2.75	2.57	2.43
12	7.33	6.36	5.63	5.04	4.59	4.20	3.87	3.59	3.36	3.13	2.96
13	9.16	7.87	6.92	6.16	5.59	5.09	4.68	4.33	4.04	3.76	3.55
14	11.33	9.63	8.41	7.44	6.73	6.10	5.59	5.16	4.80	4.46	4.21
15	13.89	11.68	10.11	8.90	8.01	7.23	6.61	6.09	5.65	5.24	4.94
16	16.93	14.06	12.06	10.55	9.44	8.50	7.75	7.12	6.59	6.10	5.74
17	20.54	16.81	14.28	12.41	11.04	9.91	9.01	8.25	7.62	7.05	6.62
18	24.84	19.99	16.81	14.50	12.82	11.47	10.40	9.49	8.75	8.08	7.57
19	29.96	23.66	19.67	16.84	14.80	13.19	11.92	10.85	9.98	9.20	8.60
20	36.11	27.90	22.90	19.45	16.99	15.08	13.58	12.33	11.32	10.41	9.71
21	43.56	32.81	26.56	22.36	19.41	17.15	15.39	13.94	12.77	11.72	10.91
22	52.65	38.48	30.68	25.59	22.07	19.41	17.36	15.68	14.33	13.13	12.20
23	63.82	45.02	35.30	29.16	24.98	21.87	19.49	17.55	16.00	14.64	13.58
24	77.82	52.58	40.48	33.10	28.15	24.53	21.78	19.56	17.79	16.25	15.05
25	95.59	61.31	46.26	37.43	31.60	27.40	24.24	21.71	19.70	17.97	16.61
26	118.62	71.37	52.69	42.16	35.33	30.48	26.87	24.00	21.73	19.79	18.26
27	149.54	82.96	59.82	47.31	39.36	33.80	29.68	26.44	23.89	21.72	20.01
28	194.05	96.40	67.73	52.91	43.70	37.34	32.67	29.03	26.17	23.76	21.85
29	264.05	111.93	76.46	58.98	48.36	41.12	35.84	31.77	28.58	25.91	23.79
30	401.75	129.89	86.06	65.53	53.34	45.13	39.20	34.66	31.11	28.17	25.82
31	781.65 / 786.65	150.77	96.62	72.59	58.65	49.38	42.75	37.70	33.77	30.54	27.95
32	457.43	175.27	108.23	80.19	64.30	53.88	46.49	40.89	36.56	33.02	30.17
33	236.93	204.25	120.98	88.36	70.31	58.63	50.42	44.24	39.48	35.61	32.49
34	131.12	238.74	134.94	97.11	76.68	63.64	54.54	47.75	42.53	38.31	34.91
35	57.84	280.02	150.18	106.45	83.42	68.91	58.86	51.42	45.71	41.12	37.43

net accelerating or retarding forces per ton. The resistance per ton for the 1,479-ton train used in the tables is 6,427 pounds while drifting and the "grade of repose" on which velocity would neither increase or decrease is practically 0.32%. Considering two other trains with the same locomotive and train resistance (5.4 lbs.) per ton, one 873 tons gross, including locomotive and the other 3,173 tons gross, the following gives a comparison of the time and distance in accelerating on descending 1.0% and 0.4% gradients:

Gross Wt. Train, tons	1,479	873	3,173
Resist. per ton drifting, lbs.	6.427	7.140	5.880
Grade of repose, per cent	0.321	0.357	0.294

TABLE NO. 4

WEIGHT CARS AND LADING 1306 TONS
WEIGHT LOCOMOTIVE 173 "
TOTAL TRAIN 1479 "

ACCELERATIONS AND RETARDATIONS

LOCOMOTIVE LOADED WITH MAXIMUM TRAIN IT CAN HANDLE ON 1% GRADE AT 5 MILES PER HOUR MAINTAINED SPEED

	LOCOMOTIVE DRIFTING AND ACCELERATING							LOCOMOTIVE DRIFTING AND RETARDING						
VELOCITY MILES PER HOUR	-1.0 GRADE	-0.9 GRADE	-0.8 GRADE	-0.7 GRADE	-0.6 GRADE	-0.5 GRADE	-0.4 GRADE	-0.3 GRADE	-0.2 GRADE	-0.1 GRADE	0.0 GRADE	+0.1 GRADE	+0.2 GRADE	+0.3 GRADE
0														
1	.09	.12	.18	.36				2009.00	353.42	193.55	133.56	101.71	82.11	69.26
2	.28	.35	.48	.78	.71	2.16		2007.36	353.13	193.39	133.45	101.63	82.04	69.20
3	.56	.68	.89	1.32	1.49	3.58	7.45	2002.44	352.26	192.92	133.12	101.38	81.84	69.03
4	.92	1.10	1.40	1.97	2.38	4.99	10.78	1994.24	350.82	192.13	132.57	100.96	81.50	68.75
5	1.38	1.64	2.06	2.80	3.51	6.75	14.79	1982.76	348.80	191.02	131.81	100.38	81.03	68.35
6	1.95	2.31	2.86	3.82	4.89	8.91	19.69	1968.00	346.20	189.60	130.83	99.63	80.43	67.84
7	2.62	3.10	3.81	5.02	6.52	11.46	25.48	1949.96	343.03	187.86	129.63	98.72	79.69	67.22
8	3.39	4.01	4.91	6.41	8.40	14.40	32.16	1928.64	339.28	185.81	128.21	97.64	78.82	66.49
9	4.27	5.04	6.15	7.98	10.53	17.73	39.73	1904.04	334.25	183.44	126.57	96.39	77.81	65.64
10	5.25	6.19	5.54	9.74	12.92	21.45	48.19	1876.16	330.05	180.75	124.72	94.98	76.67	64.68
11	6.33	7.46	7.07	11.68	15.56	25.57	57.54	1845.00	324.57	177.75	122.65	93.40	75.40	63.61
12	7.52	8.85	8.75	13.81	18.45	30.08	67.78	1810.56	318.51	174.43	120.36	91.64	73.99	62.42
13	8.81	10.36	10.58	16.12	21.59	34.98	78.91	1772.84	311.87	170.80	117.85	89.75	72.45	61.12
14	10.20	11.99	12.55	18.62	24.98	40.27	90.93	1731.84	304.66	166.85	115.12	87.67	70.77	59.71
15	11.69	13.74	14.67	21.30	28.62	45.95	103.84	1687.56	296.87	162.58	112.18	85.43	68.96	58.18
16	13.29	15.62	16.93	24.17	32.51	52.03	117.64	1640.00	288.50	158.00	109.02	83.02	67.02	56.54
17	14.99	17.62	19.34	27.22	36.65	58.50	132.33	1589.16	279.56	153.10	105.64	80.45	64.94	54.79
18	16.79	19.74	21.90	30.46	41.04	65.36	147.91	1535.04	270.04	147.89	102.04	77.71	62.73	52.93
19	18.70	21.98	24.60	33.88	45.65	72.61	164.38	1477.64	259.94	142.36	98.22	74.80	60.38	50.95
20	20.71	24.34	27.45	37.49	50.58	80.25	181.74	1416.96	249.27	136.51	94.19	71.73	57.90	48.86
21	22.82	26.82	30.44	41.28	55.73	88.29	199.99	1353.00	238.02	130.35	89.94	68.49	55.29	46.66
22	25.04	29.42	33.58	45.26	61.13	96.72	219.13	1285.76	226.19	123.87	85.47	65.09	52.54	44.34
23	27.36	32.14	36.87	49.42	66.78	105.54	239.16	1215.24	213.78	117.08	80.78	61.52	49.66	41.91
24	29.78	34.98	40.30	53.77	72.68	114.75	260.08	1141.44	200.80	109.97	75.87	57.78	46.64	39.37
25	32.30	37.94	43.88	58.30	78.83	124.35	281.89	1064.36	187.24	102.54	70.75	53.88	43.49	36.71
26	34.93	41.03	47.60	63.02	85.23	134.35	304.59	984.00	173.10	94.80	65.41	49.81	40.21	33.92
27	37.66	44.24	51.47	67.92	91.88	144.74	328.18	910.36	158.39	86.74	59.85	45.58	36.79	31.04
28	40.49	47.57	55.49	73.01	98.78	155.52	352.66	813.44	143.10	78.37	54.07	41.18	33.24	28.05
29	43.43	51.02	59.65	78.28	105.93	166.69	378.03	723.24	127.23	69.68	48.07	36.61	29.55	24.94
30	46.47	54.59	63.96	83.74	113.34	178.25	404.29	629.76	110.79	60.67	41.86	31.88	25.73	21.72
31	49.61	58.28	68.41	89.38	121.00	190.21	431.44	533.00	93.77	51.35	35.43	26.98	21.78	18.39
32	52.86	62.09	73.01	95.21	128.91	202.56	459.48	432.96	76.17	41.71	28.78	21.92	17.69	14.94
33	56.21	66.02	77.76	101.22	137.07	215.30	488.41	329.64	57.99	31.76	21.91	16.68	13.47	11.38
34	59.66	70.07	82.65	107.42	145.48	228.43	518.23	223.04	39.24	21.49	14.82	11.29	9.11	7.71
35	63.21	74.24	87.69	113.80	154.14	241.95	548.94	113.16	19.91	10.90	7.52	5.73	4.62	3.92

Accelerating force 1.0%, lbs.	13.573	12.860	14.120
Accelerating force, 0.4%, lbs.	1.573	0.860	2.120
Distance 5 to 35 M.P.H.			
On 1.0%, feet	6,183	6,539	5,949
On 0.4%, feet	53,415	97,674	39,623
Time 5 to 35 M.P.H.			
On 1.0%, minutes	4.010	4.240	3.860
On 0.4%, minutes	34.670	63.390	25.720

The above shows that the lighter train takes a greater distance and more time to accelerate between two given speeds and in the case of the 0.4% grade the difference is very marked, and that in accelerating the same distance as the 1,479-ton train the final velocity would be less for the 873-ton train and would be reached earlier by the 3,173-ton train. All trains of a district will have the same distance and grades to pass over. The following shows the time drifting the same distance with an initial velocity of 5 M.P.H. for widely different trains on heavy and light gradients:

Grade	1.0%					0.4%
Distance	3183.00			53,415.		
Gross tons train	1479.00	873.00	3173.00	1479.00	873.00	3173.00
Time, minutes	4.01	4.10	3.94	34.67	46.51	30.20
Final Vel., M.P.H.	35.00	34.25	35.00	35.00	26.10	35.00

The above is from a theoretical standpoint and in practical operation the trains on the flatter grade would be accelerated by locomotive working to some velocity approaching the safe maximum rather than waste time drifting ten miles or more to reach that velocity. The difference in time drifting is very rapidly dispelled as grade increases above 0.4%; therefore for all practical purposes trains of different weights and average loading per car can be assumed as drifting the same distance and in the same time.

The time working locomotive will vary widely, and the method of approximating this time for various weight of trains of average car loading can be best explained by taking an example for illustration. Consider a speed diagram for the tabular train platted over the following distance with the given results:

Length of district	120 miles
Controlling gradient	0.6%
Maximum tons cars and loading at 5 M.P.H. velocity on controlling grade (average car loading)	1,986 tons
Time drifting with diagram train	2 hours

Time working with diagram train..... 5 hours
Distance working ..... 90 miles

The average velocity of the train while locomotive is working is 18 miles per hour. From table 5 we find the 1,306-ton train back of locomotive can maintain a velocity of 18 miles per hour on 0.27 gradient. A table can now be prepared for the district from table five showing the velocities and time for trains of other weight moving in the same direction. The 0.27% gradient is the approximate average gradient considered for all the trains, and with the velocities for the different trains on this gradient taken from table 5, the time locomotive is working can be calculated for each. An example of such a table is presented, including a train in excess of the maximum that can be hauled over the controlling grades.

TABLE NO. 5

GRADIENTS ON WHICH GIVEN VELOCITY CAN BE MAINTAINED FOR GIVEN TRAIN TONS

TRAIN RESISTANCE, 5.4 LBS. PER TON FOR VELOCITIES 4 MILES TO 35 MILES PER HOUR

LOCOMOTIVE C.T.P. AT 5 MILES PER HOUR, 39,000 WEIGHT OF LOCOMOTIVE, 173 TONS

VELOCITY MILES PER HOUR	700 TONS	800 TONS	900 TONS	1000 TONS	1100 TONS	1200 TONS	1306 TONS	1400 TONS	1500 TONS	1600 TONS	1700 TONS	1900 TONS	2100 TONS	2400 TONS	2700 TONS	3000 TONS	VELOCITY MILES PER HOUR
5	1.88	1.66	1.48	1.33	1.21	1.10	1.00	.92	.85	.78	.73	.64	.56	.46	.38	.32	5
6	1.69	1.49	1.33	1.19	1.08	.98	.89	.82	.75	.70	.64	.56	.48	.40	.33	.27	6
7	1.53	1.35	1.20	1.07	.97	.88	.79	.73	.67	.62	.57	.49	.42	.34	.28	.23	7
8	1.40	1.23	1.09	.97	.88	.79	.72	.66	.60	.55	.51	.43	.37	.30	.24	.19	8
9	1.29	1.13	1.00	.89	.80	.72	.65	.60	.55	.50	.46	.39	.33	.26	.20	.16	9
10	1.20	1.05	.93	.82	.74	.66	.60	.55	.50	.45	.41	.35	.29	.23	.175	.13	10
11	1.11	.97	.86	.76	.68	.61	.55	.50	.45	.41	.375	.31	.26	.20	.15	.11	11
12	1.03	.90	.79	.70	.63	.56	.50	.45	.41	.37	.34	.28	.23	.175	.125	.09	12
13	.96	.83	.73	.64	.58	.51	.46	.41	.37	.335	.305	.25	.20	.15	.10	.07	13
14	.89	.77	.67	.59	.53	.47	.42	.37	.33	.30	.27	.22	.175	.125	.085	.05	14
15	.82	.71	.62	.54	.48	.425	.38	.33	.30	.27	.24	.19	.15	.10	.06	.03	15
16	.76	.65	.57	.49	.44	.38	.34	.30	.27	.24	.21	.165	.125	.08	.04	.01	16
17	.70	.60	.52	.45	.40	.345	.30	.27	.24	.21	.18	.14	.10	.06	.02	.005	17
18	.64	.55	.47	.41	.36	.31	.27	.24	.21	.18	.155	.115	.08	.04	.005	.02	18
19	.59	.50	.43	.37	.32	.275	.24	.21	.18	.15	.13	.09	.06	.02	.01	.035	19
20	.54	.45	.39	.33	.28	.24	.21	.18	.15	.12	.105	.07	.04	.005	.025	.05	20
21	.49	.41	.35	.29	.25	.21	.18	.15	.12	.10	.085	.05	.02	.01	.04	.06	21
22	.45	.375	.31	.26	.22	.185	.15	.12	.10	.08	.065	.03	.005	.025	.05	.07	22
23	.41	.34	.28	.23	.19	.16	.13	.10	.08	.06	.045	.015	.01	.04	.06	.08	23
24	.37	.305	.25	.20	.16	.135	.11	.08	.06	.04	.025	.00	.025	.05	.07	.09	24
25	.33	.27	.22	.18	.14	.11	.09	.065	.045	.025	.01	.015	.04	.06	.08	.10	25
26	.30	.245	.19	.16	.12	.09	.07	.05	.03	.01	.005	.03	.05	.07	.09	.11	26
27	.27	.22	.17	.13	.10	.075	.05	.035	.015	.00	.02	.04	.06	.08	.10	.12	27
28	.24	.20	.15	.11	.085	.06	.035	.02	.00	.015	.03	.05	.07	.09	.11	.13	28
29	.22	.18	.13	.095	.07	.045	.02	.005	.015	.025	.04	.06	.08	.10	.12	.135	29
30	.20	.16	.11	.08	.055	.03	.005	.01	.025	.035	.05	.07	.09	.11	.13	.14	30
31	.18	.14	.095	.065	.04	.015	.005	.02	.035	.045	.06	.08	10	.12	.135	.145	31
32	.16	.12	.08	.05	.025	.00	.015	.03	.045	.055	.07	.09	.11	.125	.140	.15	32
33	.14	.10	.065	.035	.01	.01	.025	.04	.055	.065	.08	.10	.115	.13	.145	.155	33
34	.12	.085	.05	.02	.00	.02	.035	.05	.065	.075	.085	.105	.12	.135	.15	.16	34
35	.11	.07	.04	.01	.01	.03	.045	.06	.075	.085	.09	.11	.125	.14	.155	.165	35

ASCENDING GRADES SHOWN ABOVE HEAVY LINE DESCENDING GRADES SHOWN BELOW HEAVY LINE

Cars and Load, Tons	Vel. on 0.27%	Hours Working	Running Time Drifting	Running Time Total	On 0.6% D. B. Pull	Grade, Veloc.
700	27.0	3.33	2.0	5.33	12,180	18.81
800	25.0	3.60	2.0	5.60	13,920	17.00
900	23.33	3.86	2.0	5.86	15,660	15.38
1000	21.67	4.14	2.0	6.14	17,400	13.89
1100	20.33	4.43	2.0	6.43	19,140	12.51
1200	19.14	4.70	2.0	6.70	20,880	11.20
1306	18.0	5.00	2.0	7.00	22,724	9.92
1400	17.0	5.29	2.0	7.29	24,360	8.94
1500	16.0	5.63	2.0	7.63	26,100	8.04
1600	15.0	6.00	2.0	8.00	27,840	7.28
1700	14.0	6.43	2.0	8.43	29,580	6.61
1900	12.33	7.30	2.0	9.30	33,060	5.45
2100	10.67	8.44	2.0	10.44	36,540	....

From this table the running time for the maximum train with draw-bar pull of 34,556 can be interpolated and will be found to be 9.79 hours total. The running time for any train with the average car loading or the tons of train for any desired schedule can be found by interpolation from the table. A very convenient form in which to put this is to plat it graphically with running time to scale on one side of chart and either the speed in M. P. H. on controlling grades, or draw-bar pull for given locomotive on the other. This is of particular value in making rating sheets for a given schedule over a district and with velocity in miles per hour on controlling grades is available for any locomotive that makes steam for full cut-off at about the same velocity as the assumed locomotive. Assuming that the traffic each way per day is twelve trains divided equally between passenger, time freight and dead freight, spaced alternately, two hours apart at beginning of runs, with schedules over district of 4 hours for passenger, 10 hours for time freight and 12 hours for dead freight, the probable number of delay points for freights would be ten for time and eleven for dead freight.

The total schedule would be as follows:

	Time Freight	Dead Freight
Water, coal, orders, etc.....	1.00 hours	1.00 hours
Meeting and passing points.....	2.50 hours	2.75 hours
Drifting	2.00 hours	2.00 hours

Working	4.50 hours	6.25 hours
Total schedule	10.00 hours	12.00 hours
Weight cars and contents (average loading)	1,126 tons	1,658 tons
D. B. pull maximum grade	19,592 lbs.	28,849 lbs.

The weight is interpolated from the table. With this data it is possible to estimate the fuel per engine mile or ton mile for the above trains, but to get the average used it is necessary to work up the data for trains in both directions. The time being calculated for the tabular train, the tables can be used in many ways for approximations.

Take the 1,658-ton train just used in the preceding example. It is desired to know the approximate tons of train of light loading of cars that can be handled over the district in the same time. The mean draw bar pull of the 1,658-ton freight on the average 0.27 per cent grade would be 17,906 lbs. If the lighter loading is such as to produce a draw bar pull of 8 lbs. per ton on the level, on the average grade of 0.27 per cent it would be 13.41 lbs. and 1,336 tons would be the approximate weight of the lighter loaded train that could be handled in the same time with a draw bar pull of 23,246 lbs. on the controlling grade. This train would make faster time on grades in excess of the average and slower time on the lighter grades, the draw bar pull being less than for the 1,658-ton train for the heavier gradient, and greater as the grade decreases below the average.

Taking the same resistance of 8 lbs. per ton for level grades, it is desired to find the additional time it will take to handle a train with the same draw bar pull on the controlling grade as the 1,658-ton train. The draw bar pull on 0.6 per cent grade is 28,849 lbs. and the train of lighter car loading would weigh approximately 1,442 ton cars and contents, or 1,615 tons gross. Take the formula $G = \frac{P-R}{20T}$; then $P = 20\,TG + R$. Substituting the values, tons of train $T = 1{,}615$; grade $G = 0.27$; train resistance on level $R = 11{,}536$, the draw bar pull on the level, $P = 20{,}257$. Table No. 1 shows this locomotive draw bar pull at 13.26 M. P. Hour. To cover the 90 miles working would require 6.78 hours or 32 minutes longer than the 1,658-ton train, and in this particular case would probably require the payment of one hour over time to the engine and train crews according to the usual pay schedule providing that all time in excess of 10 miles per hour over a district be paid for with overtime calculated for each trip to the nearest even hour.

The use of the speed diagram will show the fallacy of considering rise and fall of the same amount, of equal value. The values for the same amount will vary with the gradients, speed of approach and location. As a general proposition, with the same character and loading of a train, and where runs of 15 miles or more can be made without stops, the time over two districts of the same rise and fall will be practically the same, but the fuel consumption on the district of lighter grade will be less.

The use of the speed diagram will solve the problems of fuel and water accounts and with schedules of pay of engine and trainmen at hand the main problems of "conducting Transportation" most affected by the physical characteristics of locations can be solved. A word of caution may be well at this point. Do not use the tables herewith unless they fit the local conditions as to fuel and resistance. Where these differ materially make up a set of tables on the same principles for best results. In platting speed line, make all necessary stops for fuel, water, railway crossings, etc., and a sufficient number of other points to cover meeting and passing of trains.

The method herein described requires work and time, but it does away with the more or less "scientific guesswork" with reference to the effect of distance, gradient, rise and fall, and curvature on the main accounts under conducting transportation expenses. There will be less disappointment in the expectation of producing a decreased train mileage directly in proportion to the decreased total resistance of train resistance on the controlling gradients. The actual economies realized will be much nearer the estimated economies than the average guess work. The most important value is that it will in many cases save the waste of money in the investment of so-called improvements which fail to realize a fair return on their cost.

The value of the method does not end with the engineer's estimate of relative economies of different routes, but with data for a district once worked out, many of the important problems of movement of traffic can be solved with sufficient accuracy to place the calculated results into practice, and with possibly a few slight changes found necessary in practice, render greater efficiency in operation. The value of additional main tracks can be estimated logically so that an executive official without technical education can understand the methods of reasoning even though he may not know the mathematical methods by which you determined the running time. The time spent in preparing the tables and in making the calculations for any given lines is in itself a foundation for greater economies, and the cost of this time will bring abundant results.

AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION.

The American Railway Bridge and Building Association will meet for its twenty-second annual convention at Emerson Hotel, Baltimore, Md., October 15 to 17 inclusive.

Most of the advance copies of the committee reports are in the hands of the printer, and will soon be ready for distribution.

Reports will be presented on the following subjects: Fireproofing timber trestles; Derricks and other appliances for handling material in supply yards; Sash,— size and kind of glass for roundhouses and shops; Concrete tank construction; Best and most economical pumping engines; Roofs and roof coverings; Reinforced concrete culvert pipe; The construction and maintenance of long pipe lines for locomotive water supply, intakes, pump pits, reservoirs, etc.; The development of turntables to meet operating conditions for the modern locomotive, showing most improved practice; Track scales—construction and maintenance; Painting of structural iron or steel, for both bridges and buildings; Relative merits of brick and concrete in railway buildings and platforms.

The Atchison, Topeka & Santa Fe Coast Lines are working on plans for a large new passenger station at Los Angeles, Cal., which is expected to cost about $1,000,000.

The Blue Ridge will start work shortly on the construction of a steel trestle to replace the wooden structure spanning a creek 6 miles west of Anderson, which was recently destroyed by fire. The work will necessitate an expenditure of $50,000. J. R. Anderson, superintendent, Anderson, S. C.

The Murphy Construction Co., St. Louis, Mo., has started work on the new roundhouse in the Cleveland, Cincinnati, Chicago & St. Louis yards at Hillsboro, Ill. The structure will cost about $65,000.

The Chicago, Milwaukee & Puget Sound is expected to award a contract soon for a new freight station to cost approximately $250,000, at Spokane, Wash.

The Detroit, Delray & Dearborn has filed a petition with the Board of Wayne County Supervisors, Detroit, Mich., for permission to construct and maintain a bridge over the River Rouge. H. B. Ledyard is president.

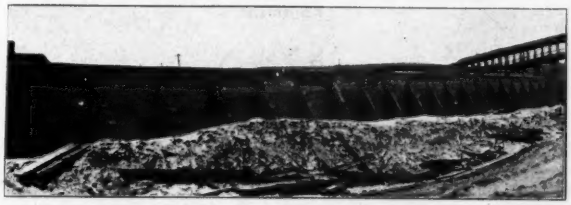
KAW RIVER DIKE CROSSING, KANSAS CITY.

In connection with work being carried on by the River and Harbor Board at Kansas City, a number of changes were made in alignment and grades on the Kansas City Southern, the Missouri Pacific and the Union Pacific.

The River and Harbor board is made up of representatives of the United States government, the state and the city governments. A concrete levee for protecting the south bank of the Kaw River is being built by the Board. The levee is made 4 inches thick with wire net reinforcement, using screenings for the coarse aggregate.

The construction of this levee necessitated changing a considerable portion of the alignment of the Kansas City Southern, and also made it necessary to add another span to the Union Pacific railway bridge. The Kansas City Southern track was moved further from the shore, and the new span on the bridge allowed the removal of a pier which was on the dyke location. All plans of the railway companies were submitted to the engineer of the Board, before being adopted.

On the plan, shown herewith, the old location of the Kansas City Southern track is shown dotted. Dotted lines also show the former alignment and location of the pier and abutment of the Union Pacific. The end span was



Back of Retaining Wall Showing Counterforts.

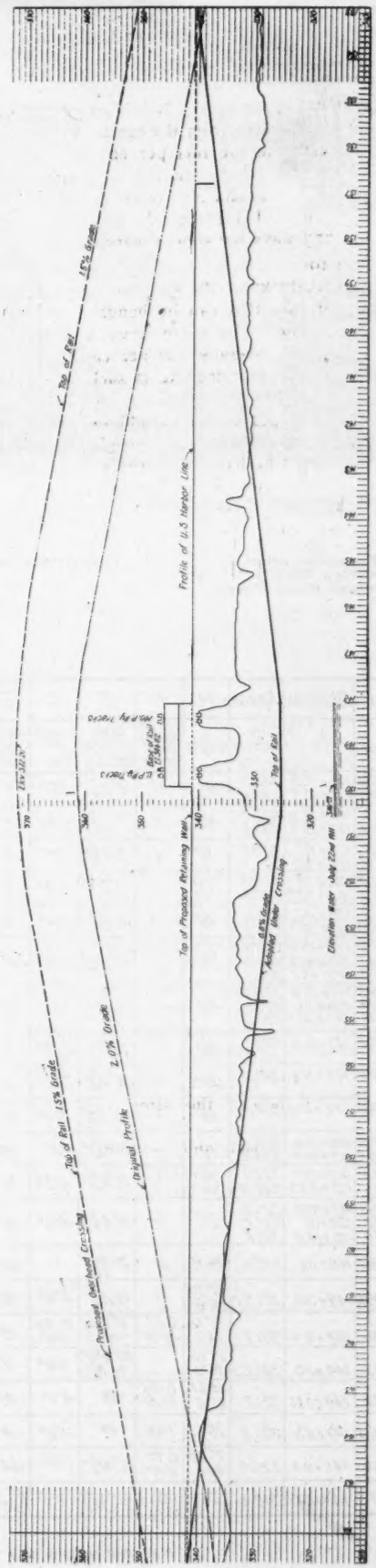
moved, as indicated, both longitudinally and transversely from the old alignment. These movements were about 125 feet endways and 40 feet sideways. The Jobson Gifford Co., of New York, moved this span in very quick time, approximately 4 hours. The span was jacked up and slid into place on skids.

The old track of the Kansas City Southern passed up over the tracks of the other railways on a pile trestle. The grade up to the summit was about 2 per cent. The changes on the lower tracks, necessitated by the work on the dyke, raised the grade on them approximately 3 feet 6 inches. This would have made it necessary to raise the elevation of the overhead trestle to give the proper clearance. In studying out the probelm, it was found that the proper elevation on an overhead crossing could be reached on a 1.5 per cent grade which of course lengthened the incline. Some little consideration was given to a grade crossing, which would have been the least expensive solution for the Kansas City Southern. However, when the original line was put in, the existing railways would not consent to a grade crossing, so this proposition was not worked out in detail.

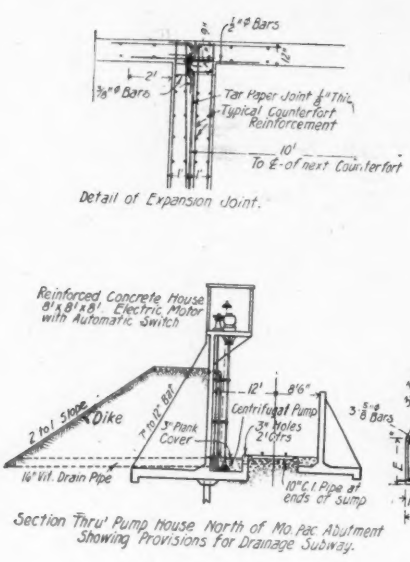
An under crossing was decided on, as an 0.8 per cent compensated grade could be obtained without excessive cost for excavation. Since the alignment was changed, the old track and structure were not in the way, making the construction much easier. The change in grade was from 2 per cent uncompensated to 0.8 per cent compensated.

Traffic was maintained over the Kansas City Southern track except for 31 days, during which time trains were run over the Union Pacific.

On the river side of the track, a reinforced concrete retaining wall was built and the levee slopes up nearly to the top. This wall is very heavily reinforced. The reinforcement for a typical section of the wall and counterfort

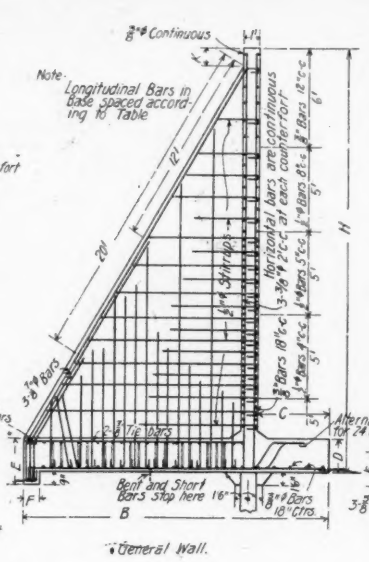


Profile Shows the Following: 1. Original K. C. S. Overhead Crossing. 2. Proposed Overhead Crossing. 3. Adopted Under Crossing.



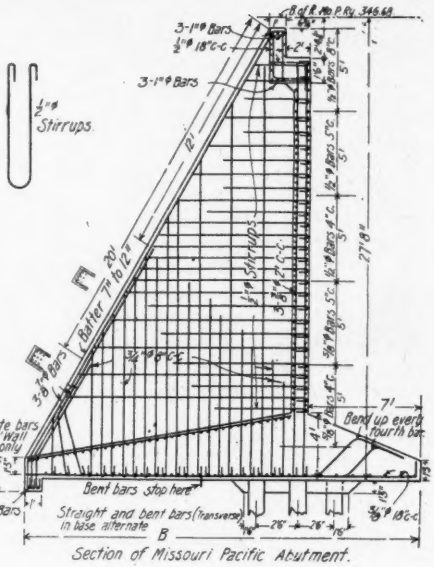
Section Thru' Pump House North of Mo. Pac. Abutment Showing Provisions for Drainage Subway.

Standard Expansion Joint for Reinforced Wall. Section Through Pump House.



General Wall.

Typical Wall Section.



Section of Missouri Pacific Abutment.

Modification of Wall Section for Missouri Pacific Abutment.

Wall Side of Track	Approx. Stations From	To	Approx. Elev. Bottom of Slab	H Height	K Top of Wall to Top of Counterfort	B Width of Base Overall	C Length of Toe	D Depth of Slab	Transverse Bars in Base Long Bars and Short Bars Alternate	Longitudinal Bars in Base Bent Bars a Straight Bars b	E Depth of Girder Overall	F Width of Girder	Vertical Bars in Each Face of Counterfort	Approx. Length of Wall
East	165+51.6	166+91.3	333.7	9'	1'	6'9¼"	1'6"	8"	½" ϕ Bars 12" ctrs.	½" Bars 12" ctrs. Top & Bottom	1'5"	9"	½" ϕ Bars 12" ctrs	280
"	169+70.5	171+10.3	333.9											
"	164+12	165+51.6	332.7	10'	"	7'7¼"	1'9"	8"	½" ϕ Bars 12" ctrs.	½" Bars 12" ctrs Top & Bottom	1'5"	9"	½" Bars 12" ctrs	420
"	166+91.3	169+70.5	332.8											
"	134+92.	136+32.	330.8	11'	"	8'4¾"	2'	9"	½" ϕ Bars 9" ctrs.	½" Bars 12" ctrs Top & Bottom	1'6"	9	½" Bars 12" ctrs	280
"	162+73.8	164+12.	331.7											
"	136+32.0	137+72.	329.8	12'	"	9'2¾"	2'3"	9"	½" ϕ Bars 7" ctrs.	½" Bars 10" ctrs Top & Bottom	1'6"	9"	½" ϕ Bars 12" ctrs	280
"	161+32.7	162+72.3	330.6											
"	137+72.	138+42.	328.9	13'	"	10'0¼"	2'6"	10"	⅝" ϕ Bars 9" ctrs.	½" Bars 7" ctrs Top & Bottom	1'7"	9"	½" Bars 12" ctrs	210
"	159+92.5	161+32.7	329.6											
"	138+42	139+81.6	327.9	14'	"	10'10¼"	2'9"	10"	⅝" ϕ Bars 7" ctrs.	½" Bars 6" ctrs. Top & Bottom	1'7"	12"	½" Bars 12" ctrs	420
"	158+52.1	159+92.5	328.5											
West	146+00	147+41.1	322.1											
East	139+81.6	141+21.6	326.9	15'	"	11'7"	3'	12"	¾" ϕ Bars 9" ctrs.	⅝" Bars 10" ctrs.	1'9"	12"	½" Bars 12" ctrs	265
West	157+81.9	158+52.	327.5											
	147+41.1	147+96	321.2											
East	141+21.6	142+61.6	326.0	16'	"	12'5"	3'3"	12"	¾" ϕ Bars 8" ctrs.	⅝" Bars 9" ctrs.	1'9"	12"	½" Bars 12" ctrs	140
"	142+61.6	143+31.6	325.0	17'	"	13'1¾"	3'6"	14"	¾" ϕ Bars 7" ctrs.	⅝" Bars 8" ctrs.	1'11"	12"	½" Bars 8" ctrs	70
"	143+31.6	144+71.6	324.0	18'	"	13'11¾"	3'9"	14"	¾" ϕ Bars 6" ctrs.	⅝" Bars 7" ctrs.	1'11"	12"	½" Bars 8" ctrs	140
"														
"	144+71.6	146+11.4	323.1	19'	"	14'9¼"	4'	15"	¾" ϕ Bars 5" ctrs.	⅝" Bars 6½" ctrs.	2'	12"	½" Bars 8" ctrs	700
"	152+20.5	157+81.9	323.3											
"	146+11.4	147+51.1	322.1	20'	"	15'6¾"	4'3"	16"	1" ϕ Bars 8" ctrs.	⅝" Bars 6½" ctrs.	2'1"	12"	⅝" Bars 8" ctrs	280
"	150+81.	152+20.5	322.3											
"	147+51.1	147+91.1	321.2	21'	"	16'4¾"	4'6"	16"	1" ϕ Bars 7½" ctrs.	⅝" Bars 6½" ctrs.	2'1"	12"	⅝" Bars 8" ctrs	235
"	149+50	150+81.	321.2											
West	149+50	150+14.5	321.2											
Sump	147+91.1	148+116	319.3	26.8	"	21'10½"	7'	24"	1" ϕ Bars 5" ctrs.	⅝" Bars 5½" ctrs.	2'9"	12"	¾" Bars 8" ctrs	20
"	149+39.6	149+50.	321.2	21' to 25'6"	"	16'4¾"	4'6"	16"	1" ϕ Bars 7½" ctrs.	⅝" Bars 6½" ctrs.	2'1"	12"	⅝" Bars 8" ctrs	10
West	147+96	148+11.1	321.2	15' to 24.6	1'0" to 0'	11'7" to 19'	3' to 4'6"	18"	1" ϕ Bars 6½" ctrs. Lengths vary	⅝" Bars 6½" ctrs.	2'3"	12"	⅝" Bars 8" ctrs	15
"	149+43	149+50	321.2	21' to 25'6	"	16'4¾" to 19'	4'6"	18"	1" ϕ Bars 6½" ctrs. Lengths vary	⅝" Bars 6½" ctrs.	2'3"	12"	⅝" Bars 8" ctrs	7
"	148+54	149+034	321.2	24'6" to 25'6	0 to 1'-0"	19'	4'6"	18"	1" ϕ Bars 6½" ctrs.	⅝" Bars 6½" ctrs.	2'3"	12"	⅝" Bars 8" ctrs	49
"	149+32.4	149+43	321.2	25'6	1'-0"	19'	4'6"	18"	1" ϕ Bars 6½" ctrs.	⅝" Bars 6½" ctrs.	2'3"	12"	⅝" Bars 8" ctrs	11
Sump	148+54	148+94	320.0	25.8' to 26.8	0 to 1'0"	21'10½"	7'	24"	1" ϕ Bars 5" ctrs.	⅝" Bars 5½" ctrs.	2'9"	12"	¾" Bars 8" ctrs	40
West Abut.	148+11	148+54	318.8	27	0	21'6¼"	7'	15" to 48"	1¼" ϕ Bars 5½" ctrs	⅝" Bars 5½" ctrs.	2'	12"	¾" Bars 8" ctrs	43

Wall Dimensions and Sizes of Bars for Different Sections.

Track Partially Completed.

Completed Grade. Dismantling of Old Trestle.

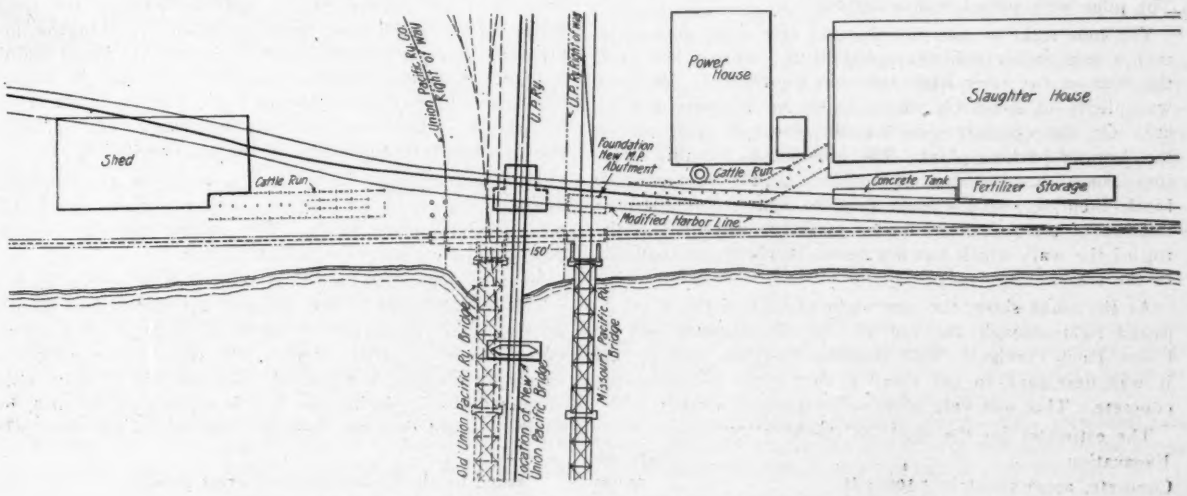
is shown in the accompanying drawing. The face of the retaining wall is 12 inches thick, reinforced by horizontal and vertical bars. The horizontal bars are tied in at counterforts by double stirrups. The horizontal bars are outside the vertical bars and the stirrups, therefore, are completely tied to the whole network of bars. The bars in the back of the counterfort are bent and hook over horizontal bars at the end. The wall has very thin sections, and heavy reinforcement; the face is 12 inches thick, counterforts 12 inches thick every 10 feet. The footing or base slab runs from a depth of 8 inches up to 18 inches, except in the sump, where 24 inches was required. At the 15-foot height (from base of footing to top of wall) the concrete required per average running foot was about 1 1/3 cubic yards. The table herewith shows the dimensions and bars for different height of wall. At expansion joints a double counterfort was used, the reinforcement, however, consisting of the same number of bars as the single counterport. Piling with an average penetration of 20 feet were driven under each counterfort at face of wall.

The Missouri Pacific abutment was built with a face wall 2 feet 6 inches thick. It is 27 feet 1¼ inches high. The base slab is 48 inches thick at the face and slopes off to a minimum thickness at the back of 15 inches.

The expansion joint used was of the design shown on the drawing. The plan shows the main wall, and one-half of the double counterfort at the expansion joint. When the forms were built, a 2 x 4 vertical timber was nailed against the end as shown. This timber was planed off slightly wedge shaped, and the broad side nailed against the form. This timber was made slightly wedge shape so that it might easily be taken out. This fillet is left in the concrete in order to prevent independent lateral movement of any wall section. Four thicknesses of tar paper are used between the wall sections. These are placed against the face of the part of the double counterfort already constructed. The next section of wall and the other half of the counterport are then poured, the concrete filling the fillet left in the former section. All forms were left until the concrete had set 48 hours.

A 6-inch drainage tile was laid at the ends of ties in the cut, and drains down into a sump at the foot of the grade, which is at the crossing.

The tile was laid in a two board trough made of inch boards with broken joints, and covered by cinders. From the sump the water is pumped into the river through a 12-inch cast iron sewer pipe, the bottom of the sump being several feet below the level of the river. The pump has an 8-inch suction and 6-inch discharge, submerged type. It is operated by a 10 H. P. Westinghouse motor taking electricity from a power company line. The motor is controlled by a Cutler-Haner self starter. This device consists of a cop-



Showing Change of Alignment on the K. C. Southern, Old Alignment Dotted.

per float within a guide, the whole being in the sump. A line tied to the float passes over a pulley wheel, and has a weight on the other end. As the float rises the weight drops. A lever connected to an electric switch is operated up or down by two balls fastened on the line. When the float gets high enough the switch closes, the motor starts and operates the pump until the water level falls far enough to shut off the current.

The pump house is located on top of the wall on a reinforced concrete slab floor, supported by reinforced concrete counterforts. The side walls and roof are of Ferroinclave concrete construction 1⅜ inches thick, with ½ inch of concrete outside of steel. The roof is waterproofed with tarred felt.

Construction work was started on the K. C. S. in January, but on account of bad weather but little was done until March, when a good start was made and the work pushed. Excavation was begun on the new right of way, practically all of it being done by teams and slips. The earth was wasted to fill in the slope on which the levee was to be constructed. This gave a handy place to dispose of material without loading, in a place where it was needed. About 20,000 cubic yards were taken out on the south end, and 10,000 on the north end.

The old trestle was taken up and loaded. Frame bents were handled by a Brown hoist, which loaded the material directly onto flat cars. The piles in the old structure were very long, running from 30 to 65 feet. The longer piles had a penetration of 35 to 40 feet. The ground was filled in, and of soft material, necessitating the extreme penetration. The piles were pulled with a derrick.

The new right of way is only 17½ feet wide; so narrow that it was rather difficult to handle the work. However, the land on the river bank side was unoccupied, and there was plenty of space on which to set up concrete mixers, etc. On the opposite side was an elevated stock run of the Armour packing plant. The foundations for this structure caused a good deal of bother. It was necessary to block them up solidly from time to time. Eventually a number of the supports for this structure will rest on the top of the wall, which has not been completed on that side of the track.

As the plans show, the new right of way of the K. C. S. passed right through the tail of the T abutment of the Union Pacific bridge. This abutment had been put in and it was necessary to cut away a very large block of the concrete. This was very slow and expensive work.

The estimates for the work on the K. C. S. were:

Excavation	$21,000
Concrete, approximately 5,500 yds	76,000

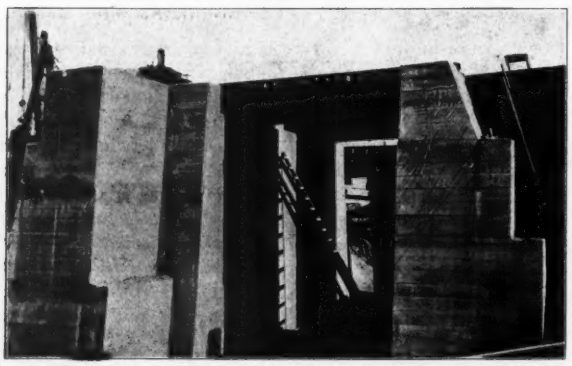
The cost of this concrete is rather high, due to thin sections and very heavy reinforcement. Steel reinforcement 250 tons (average of about 55 lbs. to the yard) in the reinforced work.

Reinforcing steel	10,000
Track, etc.	15,000
Dismantling, loading and sorting timbers, old trestle	6,000
Salvage of old material	$8,000
Total estimated cost of work	**$120,000**

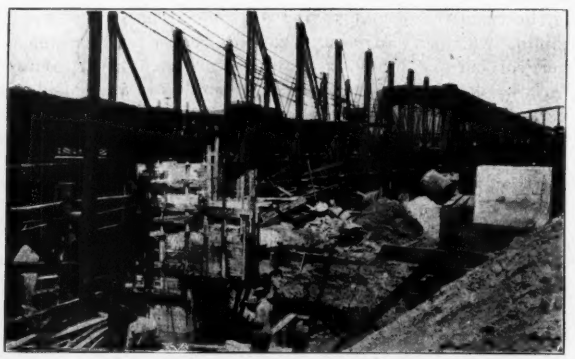
The crossing of the Union and Southern Pacific over the K. C. S. is on 21-inch I-beams, the span being 17½ feet. Both overhead railways have double tracks.

The concrete work was designed by Waddell & Harrington. The Callahan Construction Co. had the general contract. The Union Bridge & Construction Co. dismantled the old trestle.

We are indebted to C. L. Wallace, office engineer, and F. M. Plake, assistant engineer, for the information and illustrations given herein. The work was carried out under the supervision of C. E. Johnson, chief engineer.



Union Pacific Abutment and Crossing Over K. C. Southern.



Erecting Pin Connected Truss on Missouri Pacific Ry.

POLES PURCHASED, 1910.*

The total number of poles purchased in 1910 was 3,870,694. Although this is the largest total ever recorded, it is only 131,954 greater than in 1909. The increase reported for 1909 over 1908 was much greater, amounting to 489,586 poles. The demand for wooden poles, now amounting to nearly 4,000,000 annually, is supplied principally from three different sections of the United States, the northern white cedar region of the Lake states, the chestnut region of the eastern portion of the United States, and the western red cedar region of the Northwest, including Idaho, Washington, and Oregon. Southern white cedar, or juniper, is found mainly in North Carolina, Virginia, and New Jersey. At present the largest part of the cedar used is cut in the Lake states, but the indications are that the Northwest will be called upon to supply a constantly increasing proportion.

The qualities most desired in a pole timber are durability, strength, lightness, straightness, and a surface which will take climbing irons easily. The various species of cedar combine these qualities in a high degree.

Next to cedar, chestnut, oak, and pine were the leading woods drawn upon. The demand for these four species grows greater each year. Over 80 per cent of all poles reported were of cedar or chestnut, cedar alone supplying nearly 63 per cent of the total. The number of cedar poles increased slowly during the last few years up to 1909, but shows a slight decrease in 1910. The use of chestnut poles

* Issued by the United States Forest Service.

fell off considerably from 1907 to 1908, but since the latter date has again increased.

The number of oak poles purchased shows a heavy increase throughout the period covered by the table, the number purchased in 1910 being more than three times that reported in 1907. Various species of oak are utilized in different parts of the country, the more durable varieties of the white oak group being preferred. The number of pine poles has shown a slight increase for each year except 1908. Several species of southern yellow pine are used to considerable extent, principally in the Southern states. In the West another species, the western yellow pine, is reported. The latter is seldom used for poles without preservative treatment.

The number of cypress poles purchased seems to be falling off, the number reported for 1910 being only about three-fourths as great as in 1907. Cypress poles are cut only in the Southern states, mainly in Arkansas and Missouri. The use of Douglas fir in the Northwest is growing rapidly. Over 56,000 Douglas-fir poles were reported in 1910, as compared with about half this number in 1909 and less than 16,000 in 1907. Poles of several other kinds of woods were purchased in quantities of less than 50,000, of which tamarack, redwood, osage, orange, spruce, and juniper were the most important. More than a dozen other woods were utilized to a relatively small extent.

The telephone and telegraph companies, which are the principal consumers of poles, reporting 73.2 per cent of the total number used, purchased 84,195 fewer poles in 1910 than in 1909. The electric railroad and electric light and power companies, on the other hand, purchased 105,678 more poles than in 1909, while the steam-railroad companies purchased 110,471 more poles than in the preceding year.

Poles are classified commercially in 5-foot lengths and by diameters at specified points. More than one-half of the poles purchased are from 20 to 30 feet long, this being the length most commonly used by the telegraph and telephone companies. About one-fifth are from 30 to 40 feet in length and one-twentieth from 40 to 50 feet. Only about 1 per cent of the poles purchased exceed 50 feet in length. Cedar was the preferred wood for all lengths, and, in fact, in every class shown in the table, except that of poles less than 20 feet in length, cedar poles constitute more than one-half of the total. Poles of less than 20 feet in length are used largely by the rural telephone companies, which report a considerable variety of woods, prominent among which is oak.

The increase from 1909 to 1910 in the total number of poles purchased was 3.5 per cent. The largest increase for any of the several classes was that for poles over 50 feet in length, 23.5 per cent, and the next largest that for poles from 40 to 50 feet in length, 16.9 per cent. A slight decrease is reported for poles from 20 to 30 feet long.

Since the quantity of wood used for pole-line accessories is not reported for 1910, it may be interesting to note that the statistics gathered in 1909 show the purchase in that year of 3,508,695 cross arms, 6,167,795 brackets, and 18,463,041 insulator pins. Cross arms are made principally of Douglas fir and pine, brackets of oak and insulator pins of locust.

Preservation.

The great waste occasioned by the rapid decay of woods when in contact with the soil is very apparent in the case of poles. For a number of years past experiments have been carried on by private parties and by the United States Forest Service with a view to finding and perfecting methods of preventing such decay, and it may be stated that it is possible, through the proper application of certain preservatives, to increase the life of a pole from 50 to 100 per cent. The practice has proven a success economically. Not only does it lengthen the life of the pole, but it makes possible the utilization of many cheap local woods which without preservative treatment would be valueless for the purpose, thus reducing the cost of poles and transportation charges. In the principal European countries the practice of pole preservation is much more common than in this country, nearly every pole receiving a penetrating treatment with some preservative before being set. The economy of the process has been so well established that as it becomes generally understood the percentage of treated poles reported in the United States will no doubt rapidly increase and the methods used become more effective each year. The preservatives most commonly used are creosote oil, zinc chloride, and various proprietary preparations, usually antiseptic oils of low volatility.

The increase in the practice of really effective pole preservation in the United States has been retarded by the lack of pole-treating apparatus applicable to the needs of the small consumer. As a result, poles have been treated mainly by methods which do not require the use of a special treating plant and which add but few years to their service.

A somewhat more effective method is that of dipping the pole in an open tank containing the preservative. By this operation all seasoning checks are thoroughly penetrated. A variation of this method is to stand the poles upright in a bath of the preservative, making the wood of the butt end of the pole decay proof by the absorption of large quantities of the oil or solution, through the action of a partial vacuum in the wood cells created by the alternate raising and lowering of the temperature of the bath. Satisfactory plants have been devised for this purpose which are economical for firms using considerable numbers of poles annually. A plant of this type and of large capacity was built during the year in California for the treatment of western yellow pine, western red cedar, and other local woods.

In 1910 some form of preservative treatment was administered to nearly 825,000 poles, or 21.3 per cent of the total number purchased. This is an increase of 248,000 over the number treated in 1909, and of 480,000 over the number treated in 1908.

By far the larger part of the treated poles were treated after purchase, the increase in the number treated after purchase during the past few years being much more rapid than that in the number treated before purchase. The electric railroad and electric light and power companies have been especially active in pole preservation. These companies treated nearly 30 per cent of their poles, while the telephone and telegraph companies, and the steam-railroad companies each treated less than 20 per cent of their poles. These percentages indicate a large gain for each class of purchasers except the steam railroads, which treated 31.1 per cent of the poles purchased by them in 1909.

Although the number of treated poles reported is growing rapidly each year, most of these poles receive a merely superficial treatment which adds only a very few years' service. The figures for 1910 indicate that a larger proportion of the poles was treated during that year by the brush and open-tank methods than in the preceding year. Future progress in pole preservation should show not only increases in the number of poles treated but an increasing use of the more effective methods of preservation.

The Wabash has been authorized to issue receivers' certificates for terminal improvements at Detroit, Mich., costing $400,000. There is also to be a new freight house at Seventh street and a new yard at Oakwood.

The Wabash has been authorized to issue receivers' certificates to the amount of $500,000 for new locomotive shops at Decatur, Ill., which will eventually cost $750,000.

CONCRETE DEPARTMENT

Concrete Water Tanks.

THE MAN who is so busily engaged in his daily routine that he cannot find or will not take time to read engineering papers and new books will always remain in the same old rut and will not progress either mentally or financially. This is an age of progress, as is being more forcibly demonstrated every day. To be progressive, a man must be constantly informed of what others are doing and it is no more than fair that he should reciprocate at various times by letting others know what he is doing.

The man who does not follow this policy sooner or later finds that he is "losing out." He who is content to use only his own experience and his old "edition" handbooks, sees the new and difficult work assigned to one of the "up-to-the-minute" men whom the chief knows will attack the problem in an up-to-date way and produce "results."

New ideas are exemplified every day in the various departments of the railways of this country. The engineer who wishes to be kept informed of the progress in these various lines reads the engineering papers relating to such subjects, reads the latest books and inspects such new structures and plants as he may have access to. It happens very often that one article in a technical paper is worth many times the price of subscription, to the reader.

To illustrate the great strides made in the past few years, we cite the development of concrete both plain and reinforced. A few years ago the railways used only plain concrete; today all but a few of the ultra-conservative roads are using reinforced concrete for many of their structures, because of the economy and better results derived.

If what we have said does not convince you that to keep abreast with the times one must read as many of the periodicals as possible, just forget engineering papers entirely for a year or even six months. At the end of that time run through the indices (you will not need to read the articles themselves) of the various papers and we are sure that a pile driver will not have to be pressed into service to impress upon your mind what you have missed and that you have not progressed.

You undoubtedly get many ideas from reading your technical papers, and it follows that you can contributhe articles which will prove interesting and instructive to others; for the articles which you are interested in are contributed by practical men of your profession.

The contest for articles on mixing, distributing and placing concrete now being carried on by *Railway Engineering* will give many engineers a chance to contribute a share of their practical knowledge for the benefit of others. And in addition to this you will derive some benefit from putting your own ideas into words. Prizes of $25.00 and $15.00 will be awarded for the two best contributions. All articles submitted not taking prizes will be paid for at space rates.

Concrete Water Tanks.

THE Water Service Committee of the American Railway Engineering Association, in its report of 1911, goes into considerable detail in the matter of advantages and disadvantages of reinforced concrete tanks.

The advantages cited are:

(1) Low maintenance cost.
(2) Great durability.

(These are true only of well-designed, well-built and watertight tanks.)

The disadvantages cited are:

(1) Innovation in railway service.
(2) Imperfections in material and workmanship.
(3) Greater first cost.
(4) Porosity of the concrete.
(5) Shrinkage of concrete.
(6) Stretch of concrete.
(7) Difficulty of waterproofing.
(8) Effect of frost on saturated concrete.
(9) Ugliness.
(10) Immovability.

It does not appear to us as though the subject is treated with absolute fairness with respect to reinforced concrete tanks. The advantages are limited by the statement that these are only true of well-designed, well-built and watertight tanks. On the other hand, it is evident from the statement of disadvantages, that something besides a well-designed, well-built and watertight concrete tank was considered.

To treat the subject with fairness the advantages and disadvantages of a well-designed, well-built, watertight tank should have been cited, and after this a statement given of the points in design and construction which much be attained and faults which must be guarded against to obtain such a tank.

In that case the disadvantages would have narrowed down to:

(1) Innovation in railway service.
(3) Greater first cost.
*(10) Immovability.

Objection No. 2, could not have been made to a well-built tank, for in the words "well built," is implied a careful selection of material and the best of inspection and workmanship. If a reinforced concrete tank is given the same amount of inspection as a steel or wooden tank and built under as rigid a specification, this fault should not occur. The trouble is that too much is expected of concrete. There are those who come forth with the optimistic statement that "concrete is its own inspector." This is all very well,

*The numbers given are same as those in report of committee.

but a little money judiciously expended at the time of construction is better policy than that of allowing concrete to show up its own defects after the structure is finished. It is true that the ordinary class of railway laborers cannot be used to build a good tank. To construct a watertight tank requires besides brawn a certain degree of intelligence. No railway would, for one moment, allow unskilled laborers to erect a steel or wooden tank. Then why should they allow unskilled laborers to construct a concrete tank?

Disadvantage No. 4 should not be cited of a well-built tank, for in that case a careful selection and grading of materials mixed in such proportions as to give the densest mixture obtainable would have been a part of the procedure. The amount of water used in mixing, the time required to turn out batches which are uniform and properly mixed, the proper placing and tamping of concrete around reinforcement—these are things which if properly done, aid in producing a tank which will not be porous. Local imperfections found in tanks built in the past have usually been traced to poor workmanship, leaky forms, and to holding forms together and plumb with wires and block or bolts set in sleeves. Actual experience in building a tank where wire ties and wood separators were used leaves with us a forcible impression of the careful inspection required in order to do away with local imperfections, caused by the leaving of a separator in position after forms are filled. With the new type of braced, and self supporting, watertight steel forms, this cause of imperfections vanishes.

Objection No. 5 could not be charged to a well-built tank, provided movable steel forms were used which could be raised as continuous concreting progressed, thus avoiding any well defined joint between two successive pourings and also provided enough vertical steel is furnished to take care of shrinkage. Where concrete is not poured continuously, a deep groove in top of section, extra vertical steel in the form of stub bars placed at joints, and carefully cleaning of top of concrete previously poured should do away with this objection. The metal dam set in the top of each section after pouring as suggested by the Committee should perform the same function as a groove, possibly in a better manner. The bonding of two successive layers of concrete can be aided materially by removing all foreign matter from the surface of the concrete and scrubbing same with wire brushes or tooling, then wetting and covering the surface with grout and placing concrete for next section immediately. The curing of concrete also has much to do with the amount of shrinkage. Concrete kept protected and wet while curing does not shrink like that which drys out quickly.

Mr. M. A. Long, architect, B. & O. R. R., in commenting on the tank at Sir Johns River, W. Va., described in this issue, says "the concrete water tank at Sir Johns River, W. Va., has not leaked at any season of the year." This supports our contention that with well graded, thoroughly mixed concrete, watertight, self supporting forms and good workmanship a concrete tank will not be porous or leaky.

Objection No. 6, namely, the stretch in concrete, due to use of too high a unit stress in tensile steel does not apply to a well-designed tank. It has been demonstrated that to design a water tank properly the unit stress in steel should not be more than 10,000 or 12,000 lbs. per sq. in. If these stresses are used with a thickness of tank wall such that percentage of reinforcement is not too high, no difficulty should be encountered. The increase in percentage of reinforcement leads to the increase in cost of a concrete tank discussed below.

The disadvantages of difficulty of waterproofing (7) and effect of frost on saturated concrete (8), are not found in a well-designed and well-built tank. If the concrete materials are carefully graded and mixed with proper percentage of hydrated lime as hereinbefore stated the resulting concrete will be waterproof or very nearly so, and can very easily be made so, as has been practically demonstrated, by soap and alum washes. Such washes have been applied at the low cost of 0.43 cents per sq. ft. This being accomplished, objection 8 is eliminated.

Ugliness of concrete tanks applies in most cases to poorly built tanks. A well-built, waterproof tank, although simple in design and even if not architecturally beautiful, is not ugly. Most of the wooden tanks we have seen have been other than beautiful and waterproof. Many of them present a more or less arctic appearance in winter and resemble a shower bath in summer.

Judged from the standard of beauty of most railway structures, a good concrete tank would be near the top; beauty, however, is not the prime motive in an engineering structure of this kind.

We come now to the actual disadvantages of reinforced concrete tanks, well designed and well built as given in the first part of this discussion.

Innovation in railway service (1) is not so much a disadvantage as a misfortune. Like all other things which depart far from the "beaten path" of practice, the concrete tank is looked upon as something new and untried and a thing which everyone else is content to let the "other fellow" experiment with. When concrete tanks come into more general use this objection will be a thing of the past.

The greater first cost of a concrete tank over that of a steel tank of same capacity may be cited in some cases as an objection. It is our belief, however, that with good steel forms, convenient methods of supporting reinforcement and an efficient gang the construction costs can be so materially cut down that the cost per gallon capacity of a concrete tank will be equal or less than that of a steel tank. Even if the first cost of a concrete tank were more than that of a steel or wood tank the maintenance cost is so small that the first cost plus the maintenance cost of a steel tank during its life time would more than offset the cost of a concrete tank. In the long run the balance is in nearly all cases in favor of the permanent structure.

The last objection, immovability, is in fact the prime object of a concrete tank. When one speaks of concrete the first thought that enters the mind, is that durability and permanence are sought, not something easily picked up or moved. Concrete when properly put up is not of a temporary nature and should not be used where a temporary structure is desired, or best suits the purpose.

In answer to our question as to whether immovability was considered a drawback to this type of tank, we again quote from Mr. M. A. Long, who says of the tank at Sir Johns Run, W. Va.:

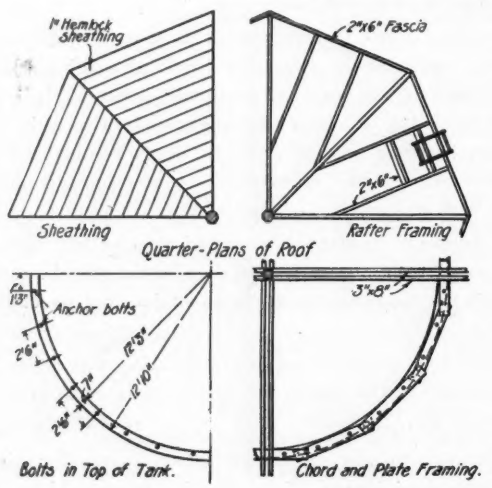
"I do not consider the fact that this tank cannot be moved a drawback to this type of tank at certain locations. At Sir Johns Run, I do not believe that the conditions will ever warrant our wanting to change the tracks so that they will interfere with the concrete tank as this location is ideal for taking coal between two division points, and the engines, will, of course, take water where they take coal. Since we have a gravity supply a short distance in the mountains from this tank and we can at all times keep a large storage of water on hand, I do not consider this permanent type of structure in this instance, a detriment."

REINFORCED CONCRETE TANK AT SIR JOHNS RUN, W. VA.

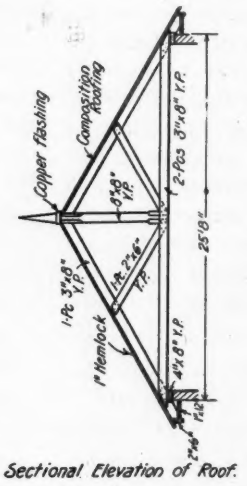
A. M. Wolf.

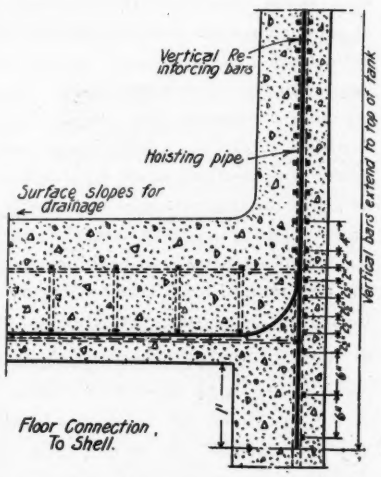
A reinforced concrete water tank of 100,000 gallons capacity at Sir Johns Run, W. Va., on the Baltimore & Ohio Railroad, presents some interesting and novel features in design and construction.

The structure, which is cylindrical with outside diameter of 25 ft. 8 ins., has a total height of 77 ft. from base of foundation to top of concrete under eaves of roof, 17 ft. of the base being underground. The bottom of the tank proper is at an elevation of 46 ft. 6 ins. above the base of footing and 30 ft. above base of rail. The portion of tower below the tank floor is divided into a basement and first story, used as pump room and storage respectively. The tank proper is 25 ft. 8 ins. outside diameter, 24 ft. inside, diameter at bottom and 30 ft. 6 ins. high. The walls of tank taper on the inside from 10 ins. thick-



Details of Tank Roof.





Detail of Floor Connection to Tank Shell.

Surveys are now under way on the proposed line of the Creston, Winterset & Des Moines, and it is expected actual work will be started on the road next month.

The Great Northern has finished laying track on the line from Fargo, N. Dak., northwest to Surrey, 225 miles. The line is half ballasted, and contracts for all the buildings and other work have been let.

A proposition has been submitted by Burns & Co., Chicago, to build from Henderson, Ky., south to Providence, about 40 miles, also a line west and south via Smith Mills and Uniontown to Morganfield. L. J. Jackson, of Henderson, is a promoter.

The Maine Central is laying second track between Gray, Me., and New Gloucester, and grades are being reduced from one per cent to 0.5 per cent between New Gloucester and Danville Junction.

The Mason City-Osage is planning to build a line from Mason City, Iowa, northeast through Plymouth Junction to Osage, 25 miles. The commercial club, of Mason City, Iowa, is to raise $30,000 as a bonus for the road.

It is reported that an agreement has been reached with the city officials of Moose Jaw, Sask., in regard to an entrance of the Grand Trunk Pacific into that place. The plans provide for building the Regina branch through the city of Moose Jaw from the southeast to the northwest.

The Camden & Gulf proposes to build a line from Carrington, N. Dak., south to Hutchinson, Kan., about 725 miles, and the prospects of building this line are good.

ness at bottom to 7 ins. at the top. The available head at base of rail is 60 ft.

The source of supply for this tank is a reservoir created by a dam across a mountain stream, a short distance from the tank. A 10-in. gravity pipe line from this reservoir conducts the water to the top of the tank, the discharge into the tank being regulated by an automatic float valve. By means of a by-pass connection the 10-in. gravity main can be turned into the 16-in. discharge line and so controlled by valves as to feed into tank or direct to the two penstocks which are located so as to be serviceable to four tracks. By this arrangement the supply is not shut off from the penstocks when sediment is being cleaned out of tank.

The 16-in. discharge pipe starts at the bottom of the tank, the end being equipped with a cast iron strainer. In the basement the 10-in. by-pass from the gravity supply previously mentioned is connected by valves to the discharge, the discharge pipe beyond the first penstock is cut down to 10 in.

Foundation—A pump with an 8-in. suction pipe to the river nearly affords an auxiliary supply. A 6-in. waste pipe with inlet at top of tank takes care of overflow in case the float valve does not work. This waste pipe has a branch at bottom of tank to dispose of sediment when cleaning out. All piping is extra heavy cast iron except that exposed to water in tank above the tank floor, that being wrought iron.

Design.

The foundation slab, 2 ft. 6-ins. thick is 33 ft. 6 ins. in diameter, reinforced with ½-in. cold twisted lug bars, placed

radially as shown on plan, with ½-in. bars bent circular to act as distributing bars. The radial bars extend from edge of slab to points underneath the 7 ft. diameter post or column, at center of tower, which acts as a support for the tank bottom and as a covering for pipes. The concrete used for the foundation was a 1:3:5 mixture. According to the designers the maximum pressure on footing for dead load plus live and wind load on tower will be 1 ton per square foot, wind pressure being a 60 mile per hour gale or about 20 lbs. per sq. ft. on diametral section.

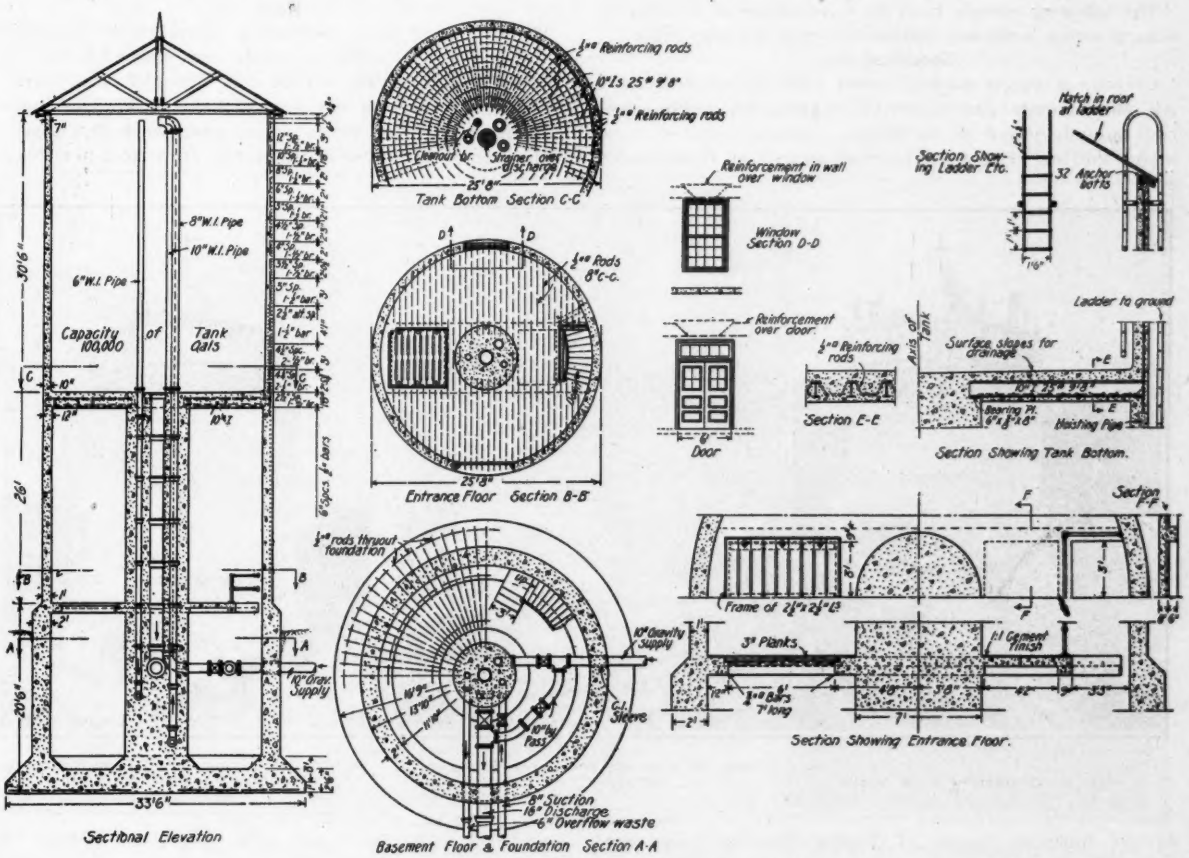
Supporting Tower—The portion of the cylindrical tower below the first floor line is 27 ft. 8 ins. outside diameter extending 17 ft. 6 ins. above top of footing. The walls are of plain concrete 1:2:4 mixture, 2 ft. thick, and 1 ft. 6 in. by 1 ft. 6 in. fillet is placed on both sides of wall at footing. At the first floor line the supporting tower is decreased to a 1-ft. wall, 25 ft. 8 ins. outside diameter, reinforced with ½-in. bars, 6 inches on centers horizontally, bent to radius of wall near outer surface. The bars are wired to the pipes used for hoisting frames for forms, no vertical bars being used in this portion. This part of tower is 24 ft. 4 in. in height from first floor line to bottom of tank floor slab. Special reinforcement as shown is provided for the portions of wall acting as lintels over door and window.

The post or column in the center of the tower is of plain concrete 7 ft. in diameter, and acts as a support for first floor and also for tank bottom. This post also acts as a support and protection for various supply and discharge pipes. At the bottom of post is a 1-ft. 6-in. fillet to aid in distributing the load to the foundation.

The first floor at entrance level is provided with an opening for stairway to basement and also with a 6 ft. square hatchway, with 2-in. plank cover. The floor slab is 6 ins. thick reinforced with ½-in. square bars 8-in. centers in one direction.

The span of the floor slab is from wall to beams, two ins. wide extending 6 ins. below slab, parallel to a diameter through hatchway and stair opening, on each side of same (Sec. F. F.) These beams are reinforced with three ¾-in. square bars 24 ft. long Cross beams of same depth reinforced with three ¾-in. square bars 7 ft. long are placed at ends of hatchway and on on side of stair opening. The floor has a 1:1 cement finish put on before the 1:2:4 concrete of slab had set.

Tank Bottom—The slab forming the tank bottom is 8 ft. 8 ins. thick at junction with shell of tank with a slope toward center for drainage. The reinforcement consists of thirty-two 10-in. 25-lb. I-beams, 9 ft. 8 ins. long placed radially from wall to the 7-ft. diameter post at the center. At right angles to the I-beams are a series of ten concentric circles of ½-in. bars, bent over top of I-beams and extending down to point near bottom of slab between beams as shown in Section E. E. of drawings. Additional radial reinforcement is provided by placing two ½-in. radial bars wired to the circular bars between I-beams and bent up into tank walls.



Section and Details, Reinforced Concrete Tank.

Tank Walls—The walls of the tank have a thickness of 10 ins. at bottom, tapering on inside to 7 ins. at top; the outside being vertical. The reinforcement consists of horizontal bars bent to conform to radius of tank with a sufficient number of vertical bars, about 1 ft. centers, to support the horizontal bars properly; vertical bars extend 1-ft. below bottom of tank into supporting walls, horizontal bars are varied as shown on drawings, a band of eight ½-in. bars at 2½-in. spacing between being placed near outside of wall at the bottom of the tank. Above the bottom for a distance of 2 ft. 5¾ ins. a double circle of ½-in. bars at 4¼-in. spacing is used and 4½-in. spacing for a

double circle of ½-in. bars for 3 ft. above this. Then a section 4 ft. 1 in. high is reinforced with a double circle of bars with 2½-in. alternate spacing. Above this point a single circle of ½-in. bars is used with spacing varying from 3 inches to 12 inches near the top.

The unit stress used in steel for design was 16,000 lbs. per square inch, no tension to be taken by concrete. The tank and tower were designed for stresses due to a wind pressure of 20 lbs. per sq. ft. on a diametral section in addition to dead load of concrete and weight of water in tank. The actual mixture of concrete used was 1-1⅞-3½ in order to obtain a very dense mixture, a 1:2:4 mix having been called for in specifications. For waterproofing, 3 lbs. of hydrated lime was mixed with each sack, or 96 lbs. of cement.

The following extracts from the specifications as to concrete, waterproofing bond and reinforcing steel are interesting.

Specifications.

Concrete—Concrete footing course shall be 1:3:5 mixture. All other concrete shall be a 1:2:4 mixture, thoroughly mixed and carefully placed in the forms. Concrete used is to be a true Portland cement and to stand all tests as recommended by the American Society of Testing Materials. The sand to be clean and sharp. The coarse aggregate shall be gravel or broken stone in size suitable for the best workmanship.

Waterproofing—Add to the entire concrete mixture a proper percentage of hydrated lime, and the entire inside and outside surface of tank and outside of outer supporting wall is to be given two coats of Bay State Cement Coating, as made by Wadsworth, Howland & Co., of Boston, Mass. Color for outside coating to be natural cement or Bedford Limestone Grey.

Bond—Work shall be arranged so that all concreting shall be completed to stopping points indicated and under no circumstances shall work be stopped below these points. Bond shall be formed at these points around the entire circumference of the previously built wall by thoroughly cleansing it with a stiff wire brush and clean water, and coating the same with a proper mixture of cement, hydrated lime and water; thereafter immediately proceed to concrete and continue until wall forms are filled.

Reinforcement—All reinforcing bars to be of sizes shown on drawing but to be material made by the Corrugated Bar Co., of St. Louis, Mo., and be cold twisted lug bar; if bent, are to be true; laps to be at least thirty diameters and wired to keep same in place, with No. 12 annealed wire, and laps shall be staggered. All other reinforcing shall be as shown on drawings.

The horizontal circular rods in the tank shall be in two lengths, with a lap of thirty diameters and each lap shall be firmly spliced with one Crosby Pattern Cable Clip, of proper size and clip splices shall be staggered.

All reinforcing to be carefully placed and held rigidly in place while placing concrete. The horizontal and vertical rods to be thoroughly wired together the entire height of tank proper and rods in tank bottom to be bent and extended upward and clipped to others.

All reinforcing bars to be of high carbon steel of a guaranteed elastic limit of 55,000 lbs. per square inch and an ultimate strength of 100,000 lbs. per sq. in.

Roof.

The roof is of wood construction covered with composition roofing. A 4x8-in. yellow pine plate, consisting of several sections is bolted to the top of tank wall. Upon this plate there is a cross frame composed of 4 pieces of 3x8-in. yellow pine framed at right angles to an 8x8-in. center post, which they support. Eight main rafters of 3x8-in. yellow pine are framed to plate and center post. Two 3x8-in. jack rafters are placed between each two main rafters. A 2x6-in. fascia is nailed to ends of rafters which are cut so as to form an octagonal roof. One inch hemlock sheathing is placed on the rafters and a composition roofing upon this. A hatch in roof provides access to interior of tank by means of an iron ladder which extends from ground to top of tank on the outside and to bottom of tank on the inside. The ladder is constructed of 2x½-in. leads 18 inches out to out connected by ¾-in. diameter rings spaced 12 ins. centers. The tank is also provided with a water depth indicator.

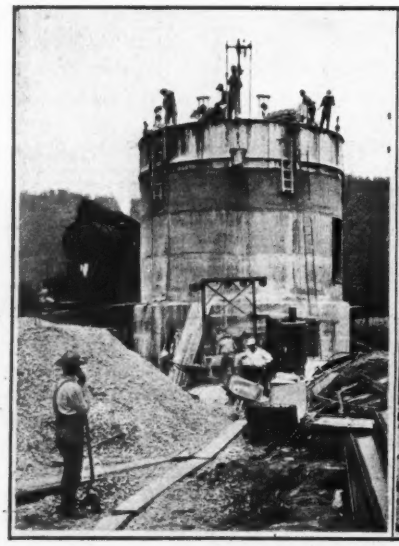


Fig. 1. Concreting Tank Walls.

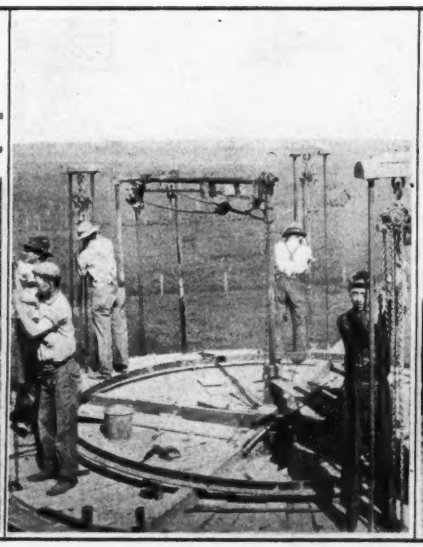


Fig. 2. Concrete and Form Hoists and Working Platform.

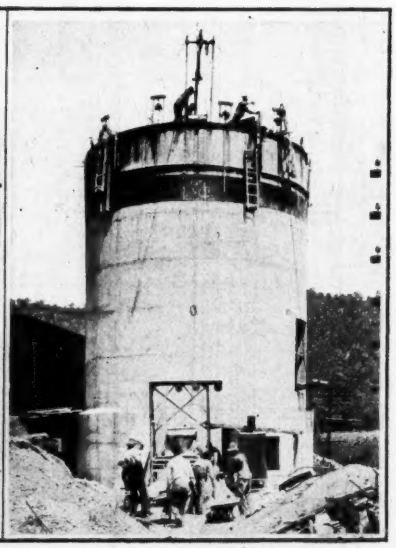


Fig. 3. Concreting Actual Tank Bottom and Section Above Tank Bottom.

Construction.

The forms used in the construction of walls of this tank were of McCoy patent, self-supporting sheet steel type. The forms are built in sections 5 ft. 6 ins. high, five sections to the circumference, with expansion joints at connections of sections. The sections, composed of 3/16-in. steel plate, are reinforced with 3x3x⅜-in. angle steel, top and bottom and at ends. The sections are held with clamps to give proper thickness of wall, and bolted together at ends, the bolts passing through holes in outstanding legs of angles riveted to ends of sections.

The forms are raised after a section about 5 ft. 4 ins. high is poured (about 2 in. of bottom of forms projecting over pre-

vious section to hold forms) by means of chains run through differential pulley blocks and fastened to top of forms. The pulleys are swung from a cross block at the top of two wrought iron pipes embedded in the concrete previously poured. Two hoists are required for each section of forms making a total of ten. The advantages claimed for these forms are that they are simple in operation, easily kept plumb and level, and close up watertight.

No staging is required where these forms are used. A platform the size of inside of tank is supported by 2x10-in. timbers placed radially resting on top of forms, incidentally holding them plumb, and held by a sleeve on an iron pipe at the center. This affords space enough to carry on concreting and bar placing. Short ladders are hung on the outside of forms at joints of sections to allow the men to loosen and tighten joints while raising and setting forms.

A hoist for concrete is formed by a pulley block and tackle supported by two pipes embedded in walls and tied to the center pipe, which supports working platform, by a trussed pipe. The concrete is hoisted in buckets, the power being furnished by mixer engine by means of a special hoisting attachment. Illustration No. 2 shows very clearly the concrete and form hoists. Illustrations 1, 3 and 4 show the mixing plant, concrete and form hoists and concreting operations.

The concrete was mixed in a Polygon batch mixer operated by gasoline engine. The sand and crushed stone were shipped in cars and unloaded at the site of tank and conveyed to mixer in barrows.

Concrete was mixed in such proportions as was found by test to occupy the least volume for a given amount of materials.

The concrete after being hoisted to working platform was dumped into trough like boxes with sloping spouts from whence the concrete was shovelled into forms, wherever desired.

One 5 ft. 4 in. section of wall was poured each day. The forms being raised, reinforcement placed, and top surface of concrete treated as described under heading of bond in specification, and the next section then poured. The center supporting column for tank bottom was carried up at same time walls were being built.

The forms for tank bottom were so constructed as to allow keying up of same after concreting had commenced, avoid settling of deck from squeeze of timbers, thereby avoiding displacement of concrete materials or disturbance of concrete while setting. This deck was left under tank floor for seven days after placing of concrete. Illustration No. 5 shows the I-beam reinforcement of tank bottom in place.

Illustration No. 6 shows the tank completed with the exception of the wooden roof. This tank was completed in the fall of 1911 and up to this time has shown no leakage whatever; it is therefore an excellent example of what can be done with a well designed and well built concrete tank. The contractors furnished a Trust Co. bond, guaranteeing tank to be waterproof for a period of 1 year in service.

A tank of similar construction was erected at about the same time for the B. & O. R. R. at Chicago Junction, Ohio, by the same contractors. This tank is of same capacity and same diameter as that at Sir Johns Run, but the height of tank bottom above base of rail is greater, being 50 ft. as against 30 ft. for the latter. The height over all from bottom of concrete foundation, which is 33 ft. 6 ins. in diameter, to top of tank walls being 93 ft. 6 ins. The structure is divided into three stories, the basement being used as pump room, second for storage, and the third story is the actual tank.

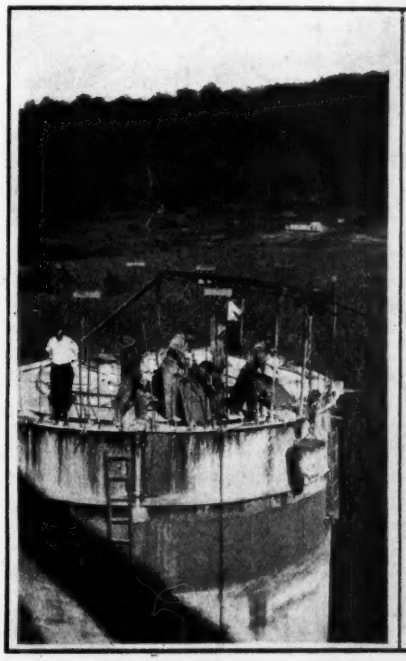


Fig. 4. Tank Nearly Completed.

Fig. 5. Reinforcement in Tank Bottom.

Fig. 6. The Completed Tank.

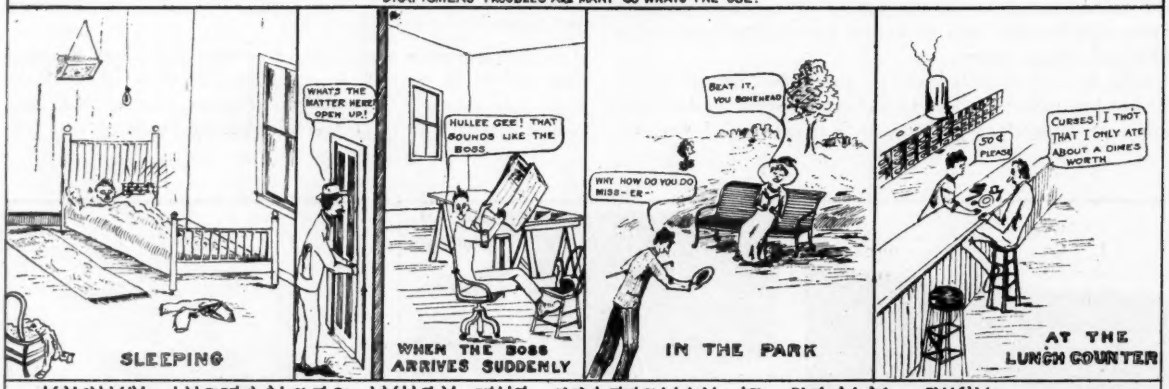
The tanks were designed and constructed under the supervision of F. L. Stuart, chief engineer; M. A. Long, architect B. & O. R. R. The Steel Concrete Construction Co., of Pittsburgh, which owns the patents on the tank forms and concrete hoists, designed and constructed both tanks; we are indebted to the latter company for the plans and illustrations shown herein.

A contract has been let to the Deiter & Wenzel Construction Company, Wichita, Kan., for the construction of a new union passenger station at Wichita to cost approximately $300,000. The work is being done in connection with the elevation of tracks through the city.

THE Engineer's Distress

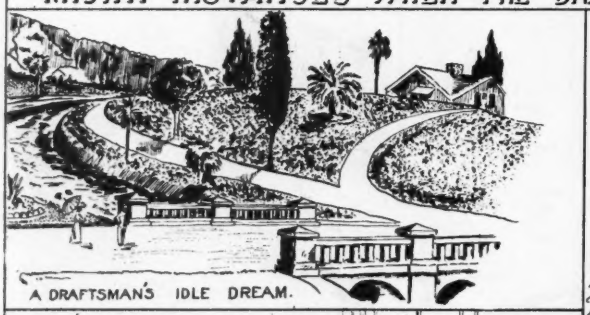
DRAFTSMANS EDITION

DRAFTSMENS TROUBLES ARE MANY SO WHATS THE USE.



KNOWN INSTANCES WHEN THE DRAFTSMAN IS REALY BUSY.

ARGUIN.



WHIFFS FROM THE OLD SPORT PIPE

Well, well, I think I will take a whack at this old pipe myself. It sure does look like smoking is.

Well I remember now, it was about 1904, I was just loafing about and having a good time when an idea struck me to go to work and earn enough money, so that I might be the better enabled to view life from a reserved seat. Well I started in as a tapeman on a railroad survey going at $35.00 per, pretty good eh.?

My hack for drawing was pretty good as I had often improved my time looking through picture books and sometimes actually study Reinhardt books on drafting,- and by the way - when I was real small I slipped away from my mothers hand one evening while she was attending an "Art Exhibit" and fell asleep behind a large picture, until I was found by one of the guards. So you see that drawing almost became a second nature.

Now as a Tapeman I was a success, and when the slump came I was made like unto boy, working for Jobs, the draftsman, a fine fellow too, who knew my ability and often had me make a few minor sketches for him when he was real busy, and do you know he recommended me to the chief to be his assistant. Well it was a case of plug from morning to night besides a good many evenings and Sundays.

But I hung on With bulldog tenacity until I was transferred to another division as chief draftsman, and then my way was easy, and my ascent up the ladder of success and fame was inevitable.

I was soon made an assistant engineer, then division engineer, Superintendent,- general superintendent and finally General manager, gee. but it was great. I was preparing now to hand it out to some of my enemies who had stepped it to me on my upward climb, and was just about to tie the can to the division engineer, when my Pipe went out.

DID IT EVER OCCUR TO YOU.?

Rube - Say mister! What are you surveying this line for - a rail road?

Engineer - No-! For $35.00 dollars and expenses.

Rube - Well you be keerful how you talk to me, young feller, you know this is my property

Engineer - (Sarcastic) Say Rube, you know there is a town in Massachusetts named after you.

Rube - (Eager to learn) What town is that?

Engineer - (Quickly) Marblehead you — — —

In Memoriam

TO ALL THOSE DRAFTSMEN WHO HAVE WORKED AND LABORED IN VAIN, FOR LITTLE AND ALMOST NOTHING, AND WHO ARE NOW

DEAD

BROKE

Personals

Joseph Ury Crawford, Consulting Engineer of the Pennsylvania, and one of the most prominent officers in its service, having reached the age of seventy years retired from active work on September 1, according to the pension rules of the railroad. Mr. Crawford was born at Ury Farm, Philadelphia, August 25, 1842, and educated at John W. Faries' school, from which he went to the University of Pennsylvania, in the class of 1862. At the breaking out of the civil war, Mr. Crawford enlisted in the 17th Pennsylvania Regiment. From 1865 to 1870 Mr. Crawford was engaged in surveys crossing the Allegheny Mountains for the Atlantic & Great Western, and in New York and New England upon surveys and railway construction. He entered the service of the Pennsylvania as senior assistant engineer of the Alexandria & Fredericksburg Railroad during 1871. He was principal assistant engineer and afterwards engineer of the California division of the Texas & Pacific, and was appointed consulting engineer of the Government of Japan in 1878.

After his return to America, Mr. Crawford was employed by the late Jay Gould to make transcontinental examinations and surveys between the Pacific Coast and Salt Lake City, as well as in Wyoming and Nebraska. In the fall of 1882, Mr. Crawford again entered the service of the Pennsylvania as chief engineer of the Pennsylvania Schuylkill Valley, and later built the Piedmont & Cumberland in 1886 and 1887. He was appointed assistant to J. N. DuBarry, Second Vice-President of the Pennsylvania in August 1889, and upon the death of that officer, was appointed engineer of branch lines. In addition to that position, he was director of various branch railways associated with the Pennsylvania system. On July 28, 1897 he was appointed chief engineer in charge of the construction of the Norfolk & Portsmouth Belt Line, which connects with the New York, Philadelphia & Norfolk. Upon the recommendation of Frank Thomson, then president of the Pennsylvania, Mr. Crawford was appointed by the Secretary of War, consulting engineer for the United States Government to examine into and report upon the transportation facilities in Cuba, which position he occupied from October, 1898, to May, 1899. On April 8, 1902, he was appointed engineer of the New York Connecting. On January 5, 1911, Mr. Crawford was appointed consulting engineer of the Pennsylvania.

C. S. Zeitler, who has been with the Chicago, Milwaukee & Puget Sound for the past six years, has resigned and accepted a position as superintendent of construction with the Flagg & Standifier Co., of Portland, Ore. Mr. Zeitler entered Washington with one of the first engineering parties which located the line of the Milwaukee, and had charge of the track laying on the St. Maries, Warder and Cour d' Alene branches.

Wm. Pitcher has been appointed general foreman of bridges, buildings and water supply, Chicago & Alton, with office at Bloomington, Ill.

George Mercer has been appointed general bridge foreman of the Duluth South Shore & Atlantic, office at Marquette, Mich. He succeeds W. N. Moor, who has retired.

R. J. McComb, roadmaster of the Wheeling & Lake Erie, has been appointed division engineer, succeeding C. A. Steele, office at Canton, Ohio.

E. S. Koller, general superintendent of the Chicago, Burlington & Quincy, has been appointed assistant general manager of the lines East, succeeding E. P. Bracken, promoted.

W. R. Hudson has been appointed assistant general manager of the Atlanta, Birmingham & Atlantic.

C. J. Rist, superintendent of the Erie at Akron, Ohio, has been appointed division engineer, succeeding A. Swartz. The office is at Huntington, Ind.

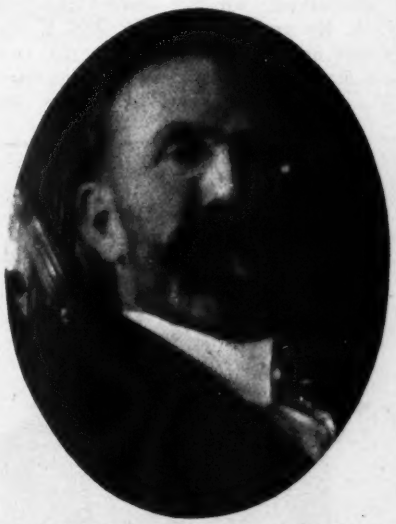
J. A. Heamen, division engineer of the Grand Trunk Pacific, has been appointed assistant chief engineer with office at Winnipeg, Man. T. J. George succeeds Mr. Heamen, with office at Fitzhugh, Alta.

G. E. Buckley, assistant engineer of the Southern, has been appointed engineer maintenance of way with office at St. Louis succeeding Edward Gray, resigned to engage in private business.

C. A. Stelle, formerly division engineer of the Wheeling & Lake Erie, has been appointed division engineer of the Chicago & Alton at Bloomington, Ill.

M. Donahoe, supervisor of roadway and structures, Chicago & Alton, has been appointed roadmaster with office at Bloomington, and his former position has been abolished.

A. R. Taylor, trainmaster of the St. Louis, Iron Mountain & Southern, has been appointed superintendent with office at Monroe, succeeding A. G. Abell, resigned.



Phil Carrol, Assistant General Superintendent St. Louis, Iron Mountain & Southern.

Phil Carroll, engineer maintenance of way of the Missouri Pacific, Iron Mountain, has been appointed assistant general superintendent of the St. Louis, Iron Mountain & Southern, with office at Little Rock, Ark.

The United States District Court has authorized the receivers of the Atlanta, Birmingham & Atlantic to issue $5,000,000 certificates, and from the proceeds of this sale to spend $621,340 for additions and betterments, and $423,485 additional for improvements at Brunswick, Ga. The additions and betterments include ballasting, widening fills, relaying tracks, etc.

It is rumored that the Atlantic Coast Line is contemplating the double-tracking of its entire line between Richmond and Jacksonville, Fla., before 1915. The distance between Richmond and Jacksonville is about 570 miles. The Atlantic Coast Line has been at work double-tracking this line in several places, and it is understood that about a third of the line has been completed.

The Atlanta & Macon has practically completed its plans and surveys and intends in the near future to start construction on its proposed high speed, third rail, electric road, between Atlanta and Macon, a distance of 88½ miles, via Jonesboro, Griffin and Forsythe. C. G. Young, Bankers' Trust Bldg., New York, has been appointed consulting engineer representing the interests financing the railway.

Officials of the Chicago, Rock Island & Pacific are reported to be planning to start work next spring on the new freight house and freight wards west of the 16th St. viaduct, Omaha, Neb. The cost of the improvement is estimated at about $1,000,000.

The Signal Department

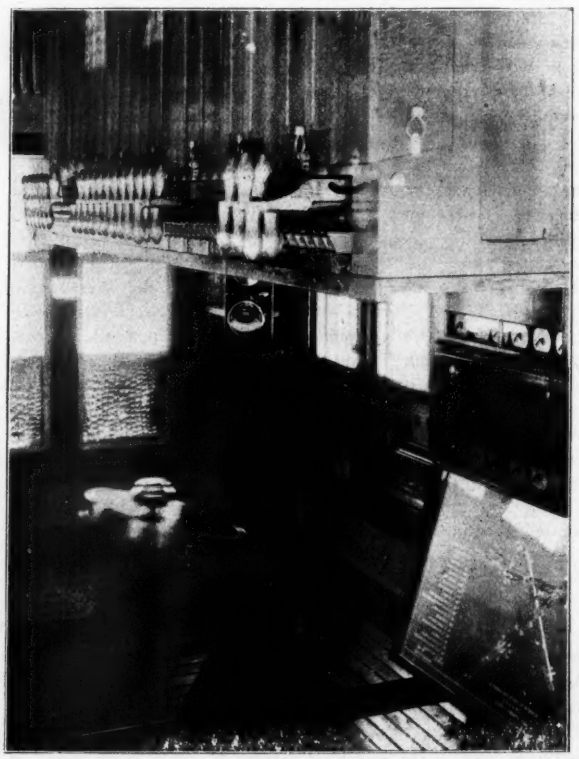
INTERLOCKING AT DES PLAINES, ILL., C. & N. W. RY.

B. M. Meisel.

A few months ago the Chicago & North Western Ry. put into service at Des Plaines, Ill., a 64-lever, all-electric interlocking, to protect the crossings of the C. & N. W. Ry., the Des Plaines Valley Ry. and the Minneapolis, St. Paul & Sault Ste. Marie Ry. The tracks of these three roads form an approximate equilaterial triangle. The result of the triangular crossing is that each road crosses the other two.

The new plant replaces an old 32-lever Saxby and Farmer mechanical interlocking, which protected the crossing of the C. & N. W. Ry. and the M., St. P. & S. S. M. Ry. In order to protect and facilitate traffic on the Des Plaines Valley Ry., a new road constructed and operated by the C. & N. W., it was necessary to enlarge the interlocking to twice its size. The outcome was a new all-electric, 110-volt plant, which is controlled by a General Railway Signal Co.'s model 2 interlocker.

Interlocking Tower at Desplaines.



Interior of Tower.

Figure 2 shows the track layout and the location of all the functions. Signals 4, 7, 56 and 61 are General Railway Signal Co.'s model 2A, 110-volt, top-post, three-position signals, operating in the upper right-hand quadrant. One of the pictures, which accompanies this article, shows call on signal 60 and signal 61, mentioned above, mounted on a two-track C. & N. W. standard signal bridge. The picture was taken from a point looking away from the plant, which gives us a view of the top post mechanisms, the C. & N. W. standard double lamp, and the marker lamp and casting. The use of the marker is in accordance with the C. & N. W. standard practice on all new work. The marker on high signal masts at interlocking plants, where only one high arm is used, takes the place of a second arm signal lamp and is located on the same side 7 feet below the top arm lamp. In automatic signal territory the markers are located on the opposite side, 7 feet below the top light. White lights are used for night indications on markers.

Signals 3, 8, 55 and 60 are call on signals, operating in the upper right-hand quadrant from 0° to 45°, governing over all routes and are non-automatic. The high arms on the same masts are semi-automatic stick signals, which govern over the straight routes only.

Signals 2 and 63 are model 2A top-post, two-position ground pole, semi-automatic stick signals operating from 0° to 90° in the upper right-hand quadrant. They are slotted through the plant only. All dwarf signals are General Railway Signal Co.'s model 2 operating from 0° to 45° in the upper right-hand quadrant. A picture of one of the dwarf signals is shown herewith. Night indications on the C. & N. W. and Des Plaines Valley are green for clear, green and red for caution, and red for stop. On the M., St. P. & S. S. M. the night indications are white for clear, green for caution and red for stop.

All switches and derails are operated by G. R. S. Co.'s model 4A switch machines. High speed derails are the Carter continuous type and low speed derails are Hayes' model AP5. All operating and control wires for all functions in the plant are carried in built-up trunking supported on stakes. A good idea of this construction may be had from one of the tower pictures.

The tower is a two-story brick structure of the C. & N. W. standard type, with steam heat. Figure 3, plans

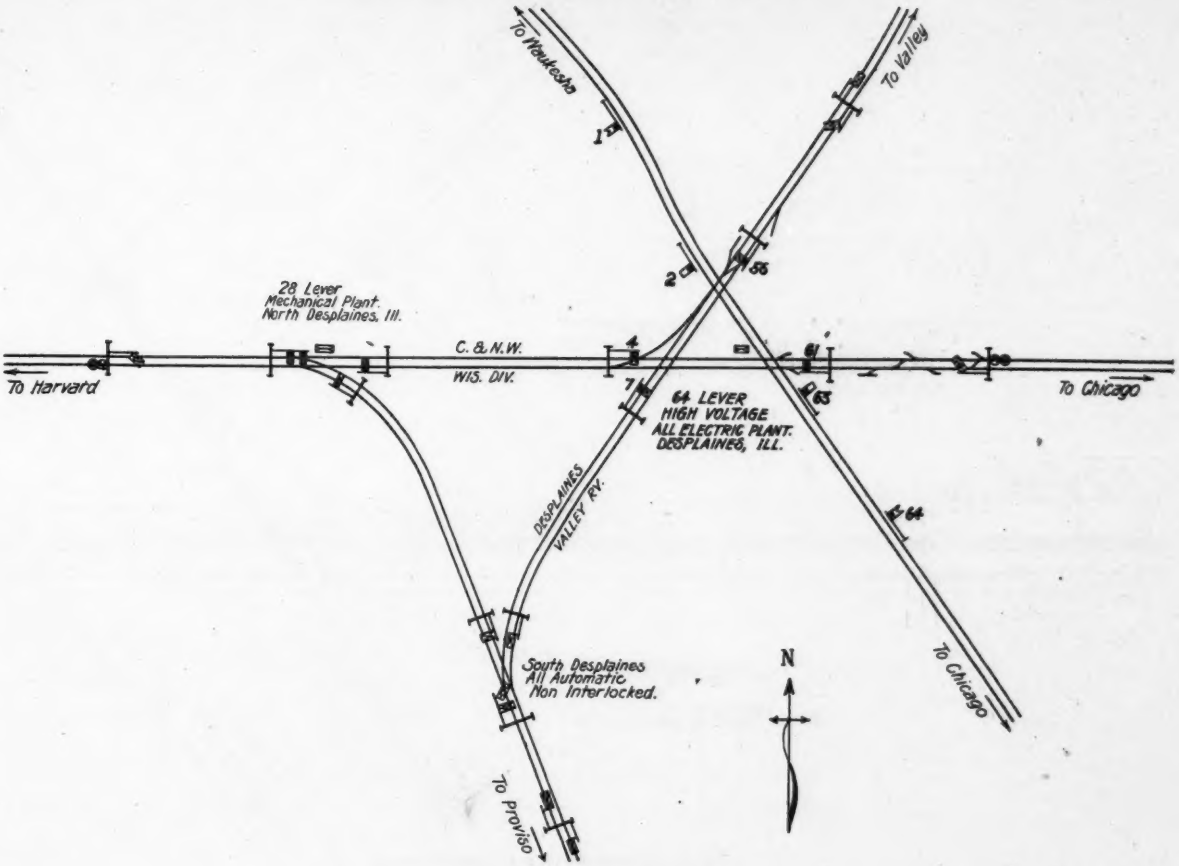
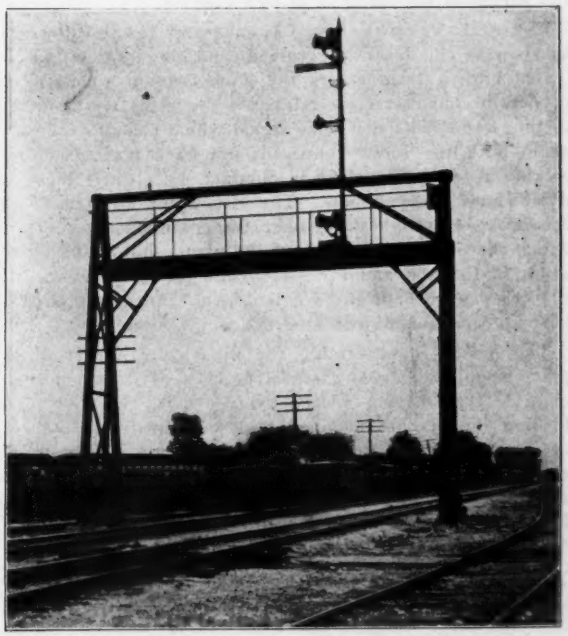


Fig. 1. General Track and Signal Layout at Desplaines.

G. R. S. Three Position Upper Quadrant Dwarf Signal.



Standard Two-Track Signal Bridge.

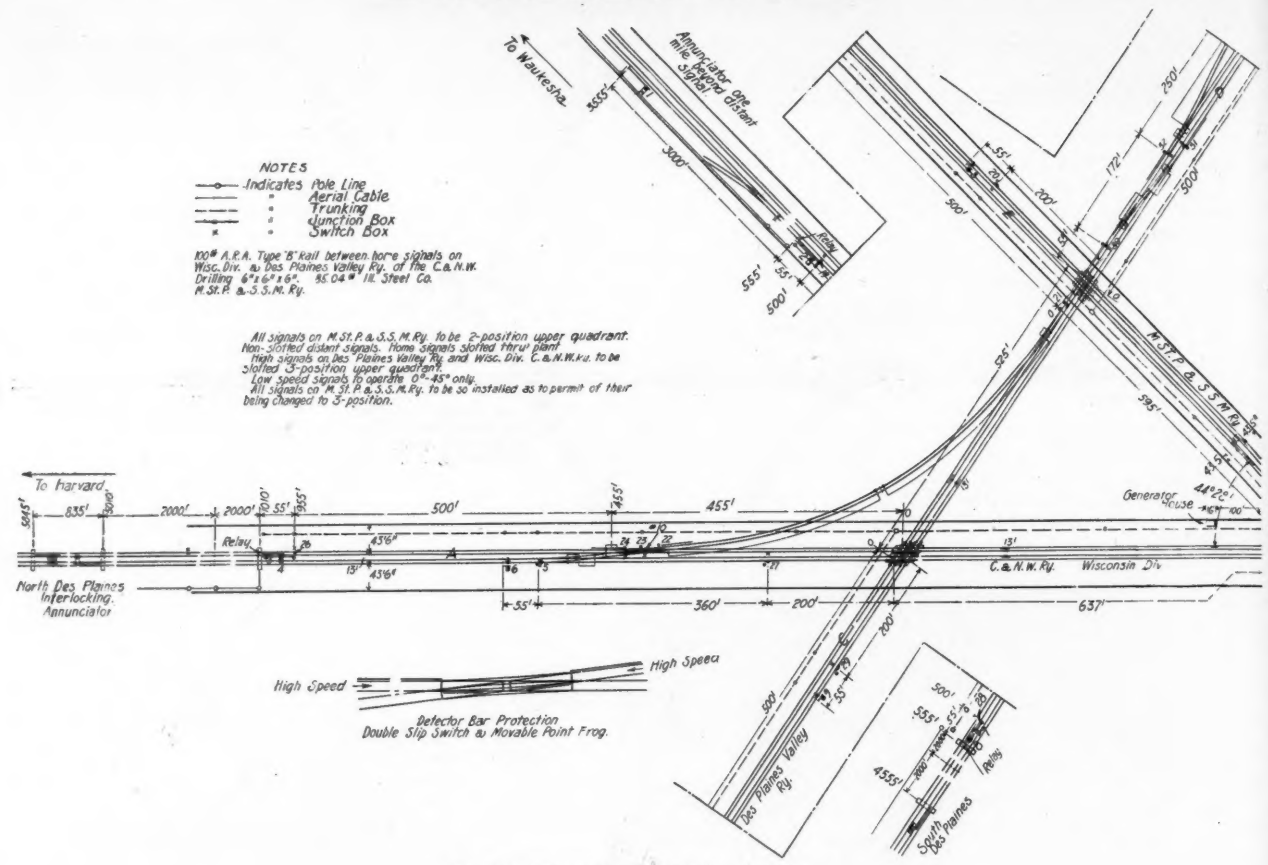


Fig. 2. Desplaines Electric Interlocking.

of the first and second floors, shows the locations of the apparatus. The picture of the interior of the tower shows very nicely the interlocker and the group of indicators back of the machine. In the corner and to the back of the machine can be seen the top of the operating switchboard. All wiring in the tower is in iron conduit.

Electric locks on the home signal levers lock up the route as soon as the lever is reversed, and these cannot be released until a train enters the home section, or until the proper mechanical screw release is reversed; the reversing of this screw slots the home signal which cannot be cleared again until the screw release is put back normal. Route locking through the plant is obtained by electric locks on derails and switch levers. The circuit for all route locks are broken through the proper track section repeaters, of which there are six throughout the plant, shown on figure 2 as A, B, C, D, E and F. All circuits furnished by the signal company are of the written form, and were found to be quite convenient for construction purposes.

The power for operating the high voltage part of the plant is obtained from a set of 57 cells of storage battery, chloride type, having a capacity of 160 A. H. The route-locking circuits are supplied with current from five cells of storage of the same type in duplicate. Current for charging the storage battery is obtained from a motor generator set and an engine and generator set. The power house is located just north of the tower, as shown in figure 2.

Figure 1 shows the general scheme of signaling and the track layout at and around Des Plaines valley for a distance of about three miles to the west on the C. & N. W., two miles to the south on the Des Plaines Valley Ry. and to

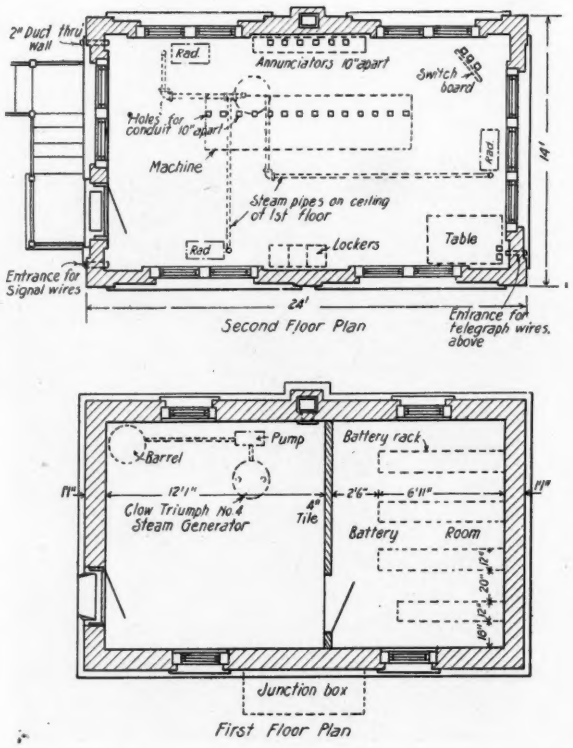
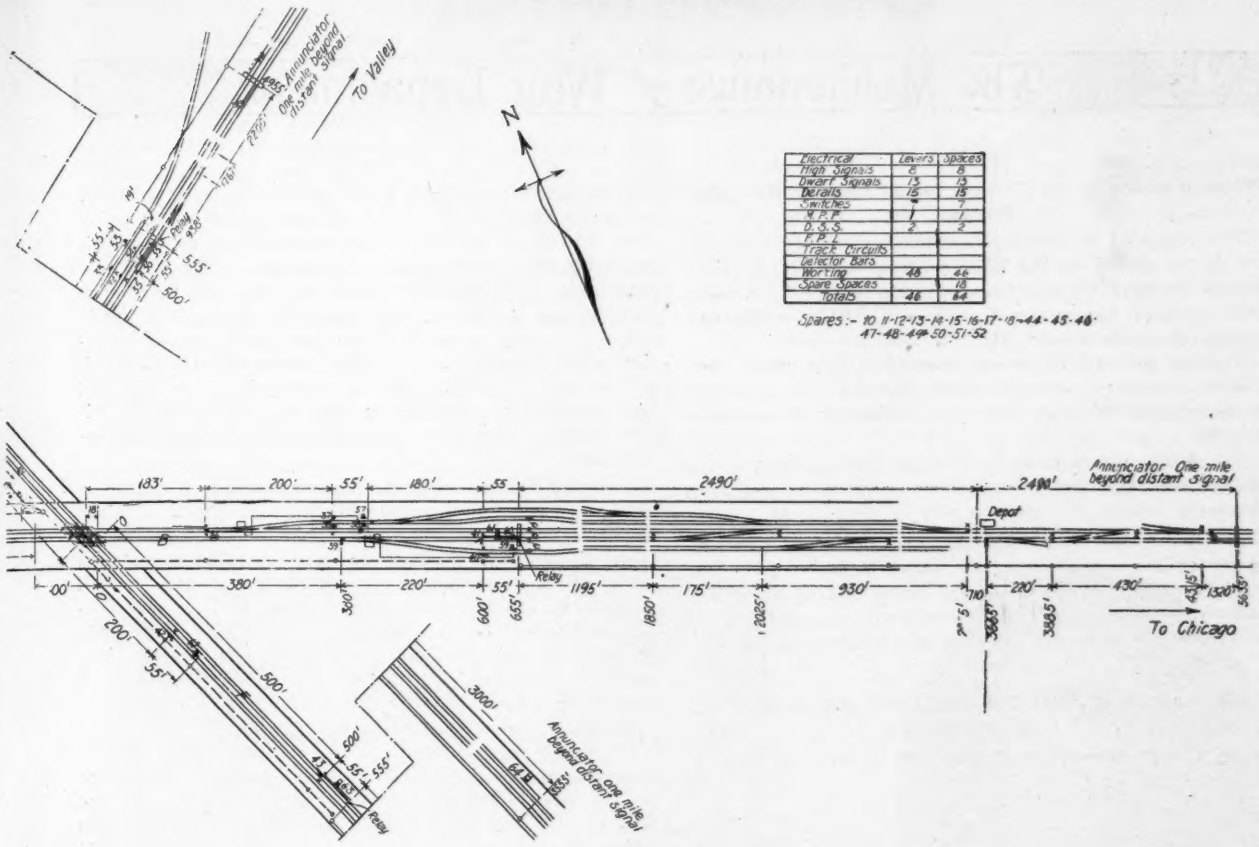


Fig. 3. Floor Plans of Desplaines Tower.



Desplaines Electric Interlocking.

the distant signals for Des Plaines in the other directions. About a mile west of Des Plaines on the C. & N. W. Ry. is located the North Des Plaines mechanical interlocking plant of 28 levers, which takes care of the train movements to and from the south on the Des Plaines valley connection. The top arm of the two-arm signal at this plant is used as the distant signal for the Des Plaines interlocking as well as the home signal for North Des Plaines. About a mile south of Des Plaines on the Des Plaines Valley is the connection from North Des Plaines, known as South Des Plaines. Automatic signals protect this connection. The second arm of the two-arm signal is the distant signal for Des Plaines and the top arm is the distant signal for North Des Plaines; both signals protect the home sections. The distant signals for Des Plaines, except those on the M., St. P. & S. S. M., are model 2A 3-position, upper-quadrant, mast-top, 10-volt signals; those on the above-named road are high voltage.

From a point near the Galena division, at Proviso, to Des Plaines interlocking, the Des Plaines Valley is now protected by model 2A 3-position, 10-volt signals. Work is now under way for a similar installation of signals between Des Plaines and Valley, the northern connection with the Wisconsin division of the C. & N. W. Ry., all work to be installed according to C. & N. W. practice.

The plant was erected by the General Railway Signal Co. under the supervision of J. A. Peabody, signal engineer.

STRUCTURES.

Farmers are contemplating petitioning the Levy Court, Wilmington, Del., to have the Baltimore & Ohio erect an overhead bridge at Concord Pike crossing. Engineers of the railroad company several months ago prepared plans for the bridge and these were submitted to the Levy Court, but nothing definite was done in the matter.

It has been reported that the officials of the Chicago & Alton have approved plans for the proposed new concrete arch bridge over the Kankakee river at Wilmington, Ill. According to the plan, the bridge will have six 50 ft. spans.

The Central of New Jersey has given a contract to G. B. Spearin, New York, for putting up a creosoted pile pier, 65x800 ft., at Jersey City, N. J., to cost about $100,000.

The Baltimore & Ohio has awarded a contract to W. F. Trimble & Son, Pittsburgh, Pa., to extend its railway sheds at Pittsburgh. Three sheds will be built, 300 ft. long by 18 ft. wide. The cost of this improvement will be $10,000. This company will build a freight house and team track at Cumberland, Md. The freight house will be 37 ft. wide by 150 ft. long, with platform extensions at both ends. The building will have concrete foundations, steel or concrete frame with rolling steel frame doors and slate roof. A contract for this improvement has been given to P. Farrell, of Cincinnati, Ohio. The cost of the work will be about $50,000. New engine terminals will also be built at Cumberland, to include a new 31-steel engine house. In addition there will be a power house 65x65 ft., and a machine shop 70 ft. wide by 142 ft. long. A cinder pit 150 ft. long will be built to accommodate engines on two tracks. There will be a reinforced concrete mechanical coaling station, with a storage capacity of 600 tons of coal and serving four tracks, also a frame sand house with a capacity of 300 tons of wet sand and 100 tons of dry sand, and two concrete inspection pits, 30 ft. long, as well as a new tank sewer with numerous branches furnishing a new water supply system. The total cost of the engine terminals will be about $500,000.

The Maintenance of Way Department

Prizes Awarded in the Contest for Articles on the Labor Problem.

The judges of the articles submitted to *Railway Engineering* in the contest on the labor problem were, H. J. Slifer, general manager, Chicago Great Western R. R.; A. S. Kent, chief engineer Monon Route, and L. C. Ryan, roadmaster, Chicago & North Western Ry.

The first prize of $25.00 was awarded to J. J. Hess, trainmaster (formerly roadmaster) Great Northern Ry.; the second prize was awarded O. A. McCombs, roadmaster Texas & Pacific Ry.

The article submitted by J. J. Hess was published in the August issue, page 393, and that by O. A. McCombs appears in this issue.

A complete list of the fifty-one names of those who submitted articles was given in the August issue.

The work of the judges was very difficult and we are greatly indebted to them for the large amount of time spent and the very careful attention we are assured was given the papers.

THE LABOR QUESTION AND ITS RELATION TO TRACK FORCES.

A. M. Clough, Supervisor of Track, N. Y., C. & H. R. R. R.

As no set of rules could be made to apply to the labor question as it confronts all of us today and particularly to cover the enormous field reached by your widely circulated Journal with the diversified condition of nationality, climate, methods of doing work and different kinds of tools and material to do it with, I will endeavor to consider it only as it relates to us in the East and to my own experience in particular with entirely Italian labor, and where I am never very many men short on a division of 300 miles of track with all the appertainments of a main line division of the New York Central & Hudson River Railroad.

In the first place, I know it is not an easy matter to handle a section or extra gang of from ten to twenty-five men when sixty-five per cent of them cannot speak or understand the English language, and as much cannot be accomplished as we did years ago with our own labor; but I will endeavor to show how we can materially help both to get and keep those men and get somewhere near the full measure of their ability for the wages paid them; and it should be understood at the beginning, and I am sure we would all appreciate the fact if similarily placed, that a man who cannot speak our language or understand what we say, is suspicious to a very high degree, and a gesture is many times misunderstood and causes a hitherto docile man to show a small amount of combativeness that spoils him and gives him a bad name ever after, It also causes him to rely a very great deal on a friend who does know a little of our language and who through a slight misinterpretation of a roadmaster or a foreman's words or actions may become intractable and will communicate this spirit to one or many of his countrymen near him at such a time with very bad results.

It is only necessary to look at a gang of this class of men for a few minutes where those conditions exist to know that the foreman does not have their confidence. They are also very sensitive in money matters, and any slight error in their time or amount due them causes them to be distrustful and cunning to watch and if possible, beat the foreman or timekeeper if they can; so that men in charge of foreign labor should be strictly honest with them, giving them all that is due, and be just as kind to them as in his judgment the circumstances will warrant. This does not mean that they should be petted, but they are very much more susceptible to just treatment than they are to abuse, and will respond in manifold ways to the known appreciation of the supervisor. If satisfied, these men will tell their friends and they will come to work with them and will stay indefinitely in one place; thus they become more efficient and naturally more valuable to the Company employing them.

It should be the constant endeavor of men in charge of foreign labor to discourage the habit of those in other departments making light of this class of men, referring to them as "guinea," "dago," etc., and charging them with every offense that happens in the neighborhood, as well as doubting the ability of those of them who are more enlightened and placed in positions of trust. Many deplorable instances of this kind have come under my notice, and while it is not claimed that they are above reproach, I believe that a more liberal attitude toward them would make a decided difference in the morals of these people.

I get my men from an accredited labor agent who is under bonds to our Company and who furnishes them with all the vituals they use of their own peculiar kind, and who is protected by the Company up to a certain sum which is deducted from the wages of the men and paid over to the agent by the treasurer. We carry all the necessary supplies for the men from the agent's headquarters to the places where the men are located free of charge, and give the labor agent and three or more assistants transportation over the districts assigned. They make frequent trips to the men's camps, boarding cars or boarding houses to see that they are properly cared for, kept clean and are well fed. We transport men from the cities in which we secure them to their work free, and give them individual passes when requested for personal business. For section gangs, clean, comfortable boarding houses are furnished, some of concrete, and some of wood, with good wells of water close by, with plenty of fuel to keep them warm in winter time. For extra gangs we furnish clean, commodious boarding cars and place them on cut-out tracks so that they are not molested by switching at any time, and where we have large construction work in progress, we build large airy shanties with a store and storekeeper to care for them, and it is quite gratifying to see how contented and happy these people become under such circumstances.

We pay wages equal and in some cases slightly better than other roads in our vicinity and while at present, when laborers are exceptionally scarce, we do not have full gangs, ordinarily we can get all the men we want, largely through those we have sending or bringing their friends. I use all native or white foremen on sections and extra gangs but use foreigners as assistants, many of whom are very efficient trackmen today. All our foremen have full authority to hire or discharge their men, but we insist on them using the methods set forth in this article. We have a pension system in which both foreman and laborer are eligible.

I may be more favorably situated than some of my brother trackmen in the South and West, but some of these methods can be used in any part of the country and I am sure if fully carried out will give surprising results.

ADDRESS OF PRESIDENT BURNETT AT FIRST CONVENTION OF THE MAINTENANCE OF WAY ASSOCIATION.

At St. Paul, Minn., on September 15th, 1883, the first convention of the Maintenance of Way Association, now called the Roadmasters' and Maintenance of Way Association, was opened by President Burnett with the following address, which is reprinted here as of general interest to the present membership:

Gentlemen of the convention, we have met for the purpose of mutual improvement, which is certainly the chief object of this convention. This being our first meeting, it is sufficient to say that by these meetings we will become more proficient in our duties individually, and more noticeable, at least, as a class. The rubbing together of two rough surfaces makes each smooth, even polishes, and coming in contact with each other certainly cannot but improve us, as our object is to throw off that which is useless and impracticable, and acquire that which is useful and practical. We are ambitious to be recognized, and by thus intermingling with each other, exchanging ideas and opinions relative to our line of duty, we may learn otherwise than by that sometimes severe teacher, experience.

Experimenting on railroads, especially within our line of business, is hazardous in the extreme; in fact it does not pay when it can be avoided, as it is expensive to our companies and may result in the loss of life. By reason of this association we may all profit by one example, so that the time spent here is far from being misspent, and is undoubtedly of value to our companies.

It seems unnecessary to call to the mind the prodigious proportions which railroads have assumed, and still, the "good work goes on." But a few years ago the hardy pioneers, many of them our fathers, with but a scanty outfit preceded railroads into almost trackless wastes to bring method out of chaos; many were the terrors of pioneer life to the settlers cut off from the world they left behind, dependent entirely upon their own skill and energy for their sustenance; their lives were unenviable in the extreme. Many perished for want of the necessities of life, and the development of this great nation was comparatively slow, and attended with many adversities and privations. But a new era here presents itself. Next to Christianity I believe that railroads are the greatest aids to civilization. Many times they precede settlers into almost unknown territory and stretch branches in every direction. It invites the ambitious husbandman to a home, guaranteeing that the products of his labor shall be readily exchanged for the comforts, the luxuries, if you please, of life.

The first trip of the locomotive across the barren prairies drives the buffalo and the wild deer into confusion. The North American Indian gazes upon it in astonishment; it teaches him a lesson upon the inferiority of his race; that but shortly his hunting ground will be turned into a state of productiveness, and he turns toward the setting sun in abject despair.

But a few years thereafter and the tourist gazing through the car window, as the same engine pulls him along, sees the mellow earth turned toward the sky, lightly covering cereals which betoken fair harvests blotting out the wild grasses forever. School houses dot the prairies as far as the eye can discern. In every direction are pleasant farm houses, lively villages, churches of every denomination, and occasionally a metropolis relieves the former monotony; all these stand indebted to the great corporations we represent.

I consider the public ungrateful to its greatest benefactor when by legislation the government endeavors to hamper and overburden our corporations. The latter are constantly met by absurd enactments from which only resources to higher courts can free them. Everyone, it seems, takes delight in venting his spleen upon railroads. There was a time when railroad men were almost ostracised by society, looked upon as belonging to a class unworthy of admittance to its enchanted circles. Some members of the "great army" being almost constantly away from the restraining influences of home brought upon us as a class a stigma which we are constantly wearing away. Good examples set by superiors have greatly improved the rank and file. The parlors of the elite are no longer denied to us, and today I am proud of the title of "railroad man," for among our number can be found men of sterling qualities, bright intellects, with pleasant homes and interesting families. Although as a class we are not generally wealthy, our children receive proper instruction which fits them for all the walks of life, and we are therefore rich in the bright hopes which make our lives enjoyable.

Our department of railroad work is comparatively un-

A. M. Clough, President. T. F. Donahoe, First Vice-President. M. H. Connolly, Second Vice-President.

Officers of the Roadmasters' and Maintenance of Way Association, 1911-12.

known; you may look in vain among the various encyclopedias for a treatise upon the title "roadmaster," even that great repository of words and wisdom, "Webster's Unabridged," entirely ignores us.

Nevertheless, we have a very lively existence, and while I would not detract from any class the honor which courage has brought through peril, I consider that we have not received sufficient consideration. The daily press glows with the heroic conduct of some engineer, who, at the peril of his life, has stopped his train loaded with human freight. At the very brink of destruction some fireman has crawled out on the pilot and snatched a child from the rails in time to save it from a horrible death. Conductors and trainmen have all received merited praise, but there is not one word for our heroes of a dollar and a shilling a day. If their diligence, their energy, their carefulness be in the least diverted, the train cannot be rescued from the dangers that lie hidden beneath the rail. They are out in the severest weather, the unmerciful wind cutting their brown faces. The broken rail is replaced thousands of times when only they know of the services they have rendered. Patroling their divisions at night when the earth is veiled in darkness, when the heavens appear to have determined upon again flooding the earth, their bodies covered with wet clothing, they cannot return to more comfortable quarters for there may be a dangerous washout ahead. It is discovered; the coming train is flagged, the track repaired, but their heroic conduct is unheralded, unknown. How many of us there are, who can point to scores of just such cases as this; the broken rail; the washout; the landslide; the culvert gone; the bridge unsafe; and many calamities averted by the diligence of these, our honest and faithful subordinates. In times of danger our hopes are centered upon them and the full performance of their duty, and how rarely are they misplaced! From my experience I am free to venture the opinion that less casualties occur by reason of their negligence than from negligence in other departments. Knowing the value of their services we can only repay them by our manifestations of approbation. I fear that this is often disregarded. The true "roadmaster" should so deport himself that his presence alone will be a source of pleasure to his subordinates. An austere general is not loved by his soldiers. Too many of us lose sight of this fact and speak hastily and harshly. We should make ourselves understood in a courteous and gentlemanly but firm manner. Our duty often demands severe exposure on our part, but change places with these men; eat cold dinners during cold weather, and pump a hand car six miles against the wind, handle cold tools all day, then go home to meagre meals, almost destitute of any kind of luxury, and I am sorry to say, many times of necessities even, then you can appreciate their position; or when the hot summer's sun concentrating its heat by reflection on the road bed, dazzles their eyes, withering vegetation and scorching humanity to a blister, then it is that we wonder that they have ambition enough to perform their duty aright.

But men long identified with railroads become parts of them, and superiors cannot do too much to assist them in their labors.

As we are undefined let us define ourselves. No better definition can be given than that suggested by the term "roadmaster" itself, which implies "master of the road." By becoming proficient in our departments we may surely merit the term. No position demands more careful study and attention. One of the most essential things is the employment of experienced foremen, men of native ability who have earned their own promotion; for these, our lieutenants, are often placed in positions which demand a thorough knowledge of railroad affairs. They cultivate discipline among the laboring classes and inaugurate on a small scale a sort of "civil service reform." It encourages men in the discharge of their duties, and they feel an interest in their work. Our corps may then be more potential. I sincerely hope that these meetings will continue yearly, and with a good attendance they cannot but be beneficial to us and to the companies we represent.

L. C. Ryan, Secretary.

James Sweeney, New Member Board of Directors.

Officers of the Roadmasters' and Maintenance of Way Association, 1911-12.

The New Orleans Terminal Co., A. D. Lightner, president, New Orleans, La., will at once complete the marine slip at Port Chalmette, upon which work was suspended in 1907, and which will cost complete in the neighborhood of $3,500,000. In addition to this the company will reconstruct one ship berth in length of the present wooden structure containing five berths at Old Port Chalmette. Bids have already been taken on this work.

The Mount Ida, Ouachita Valley & Hot Springs has been chartered with a capital stock of $80,000 and proposes a line to run from a point on the Gurdon & Fort Smith road, north of Caddo Gap, to Mount Ida, a distance of eight miles. Col. O. C. Godman, Fort Smith, Ark., is the promoter.

TRACK LABORERS.

O. A. McCombs, Roadmaster.

To get the best labor, employ section laborers in the local market or the vicinity where the work is to be done. We find such men are better laborers and give better satisfaction than imported laborers. For our extra gangs we employ mostly foreigners and under the conditions they are worked here, among a strange people not speaking their language, they are not very good labor. No gang of men working on track, that needs an interpreter, will give satisfaction. Practically none of the gangs of men that are shipped out to the railroads give satisfaction as a whole. Many of them seem to get an idea in their heads that men are so scarce that all you want is just so many men on the pay roll. And it is a hard proposition to get a day's work out of such men. They are the most dissatisfied laborers we have to deal with and give the least satisfaction.

One way to remedy this would be to compensate the men for the amount of work they do so that the men would hunt the work instead of the work hunting the men.

It is not difficult to get a fair day's work out of the laborers we hire in the local market. Both foreigners and natives do good work if you have a good foreman.

But with the laborers that are shipped in by labor agents and "men grabbers" for extra gangs and special work it tries a foreman's soul, who has the patience of a Job, to get a day's work out of them. It is not always practicable to try and increase the amount of work being done by a gang. If you have a good gang and a good foreman doing good work and a sufficiency of it or as much as any other man could do under similar conditions, do not spoil the whole thing by driving him beyond the limit. But do your best to keep him at his best. Encourage him and the men all you can, keep them at it and be content. On the other hand if there is not enough work done for the amount of labor expended, look into the matter, search out the trouble, and remedy it. The trouble may be in the foreman or perhaps in the men or perhaps with the conditions under which they have to work. Each case should be judged on its own merits, and remedied accordingly.

All section laborers should be furnished a house to live in, and fuel and water, and a garden patch on the right of way where practicable. There should also be provided a place where they could get groceries, dry goods and a little money as soon as they have time enough in to pay for what they get. A great many laborers would go to work on track but cannot wait until pay day for their money. They must have provisions at once or they cannot work. The section laborers we have here, mostly negroes, make good track laborers. They do good work with a good foreman.

The imported men from the cities or other far away places are hard to get along with. Nothing pleases them from the size of the shovel they work with to the victuals they get at the boarding cars or section house.

I saw one of these gangs strike because they did not like the assistant foreman; at another time one of these imported gangs struck at a wreck because they did not get their supper on time, and they walked nineteen miles to the boarding cars. They got in a little late for supper any way. It was lucky for the railway that we had plenty of faithful section men to clear the track and get trains moving again.

We always treat our men considerately, although sometimes we drive them. There are times in railroad work when we must hurry and the men understand that. I have hurried my men at times to the very limit of physical endurance, sometimes in the very hottest weather. But we always treat our men fair and square. In the course of events while waiting for or riding on trains they get rest and breathing spells to make up for the rush work.

The most important thing in track work is a good foreman; and if there is anything more important about track labor it is another good foreman. The mistake is frequently made of giving a foreman too many men to look after. A foreman should not have any more men than he can personally look after. He should see that all the work is properly done and not leave it to the men to do a foreman's work. The work would not have to be done over and labor wasted, and we would get better results at less cost. Of course the number of men a foreman can look after depends on the kind of work a gang is doing. On some work a man can handle a great many more men than on other work.

When I say a good foreman, I mean a man that is a good track foreman for either a section or extra gang, as the case may be. He should be a man of good executive ability and know how to do his work with the least expenditure of energy. He should know how to accomplish a certain piece of work with the least possible labor; how to manage his men and get a full day's labor out of each one each day, in order to be fair to himself, to the men, and to the company he is working for. The compensation for section labor should be as much as is paid for laborers at other work in the same locality where the track work is being done; not the highest wage that is paid in the busy season when labor is scarce nor the lowest that is paid when men are plentiful, but an average wage the year through that the men could depend on getting right along if they worked. The number of men in a regular section gang can be so regulated in Southern states that it would not be necessary to reduce the gang or lay the gang off except in very unusual or extreme cases. Nothing demoralizes a gang quicker than to lay them off or reduce the force. The men that are left think they will be laid off or cut off next and they begin at once to look for another job.

A good plan when men get scarce and it is desired to give them an extra inducement to stay on the section is this: When a man works the six working days of the week, give him time for Sunday without any work if he will stay about the section house on Sunday. This keeps him on the section and away from town, and from the labor agents and others wanting men, who would persuade him there was a better place somewhere else.

No matter how scarce men are, a foreman should not temporize with the men about the work. All the men that go out to work should do a day's work or else be put off the job, and gotten rid of. I have heard a foreman say when asked why the work was not getting along faster, that he could not say anything to the men or they would walk off. Let them walk off, if you cannot say what you should say to them about the work without having them quit. It is well to be rid of them. To do justice to the regular section laborers who work on the track and do no other kind of work, the wages ought to be raised a small per cent each year they put in continuous service until the wages reached an agreed maximum. After certain periods of service they should be allowed passes over the division for themselves and families if they requested them.

Treat your men fair and square all the time in all things. See that they get out to work on time and that they get in from work on time, and see that they get pay for all the time they work. There is no class of labor that is worked under more variable conditions than track labor; from sea to sea, from the equator almost to the Arctic Circle, you find section laborers. So each one must be governed to a great extent by the restrictions and conditions under which he is working.

OBTAINING BETTER LABORERS.

J. A. McRae.

The difference between section labor conditions now and twenty years ago was forcibly illustrated by a recently observed incident. Five "sons of sunny Italy" were carrying, on their shoulders, a soft wood tie, and it is perhaps needless to say they were not hurrying. A gentleman with a brogue standing by called attention to them with the remark, "See thim five dommed Dagoes bateing wan good Irishman out of a job."

Everybody knows, regrets and complains about the decreased efficiency of track labor, but the steps taken to remedy the condition are mostly in the wrong direction. "Backward, turn backward, Oh! Time in thy flight" has always been a vain prayer, and we shall make no effective progress, marching with our faces to the rear, though an occasional look back may be profitable in locating accurately our present position. A goodly number of high officials having corroborated the testimony of a general manager who recently wrote, "Section labor becomes more costly and less efficient every year." That proposition will, for the purpose of this paper, be assumed as proven.

Twenty years ago, in Nebraska, farm labor was paid, on yearly contract, $13 to $18 per month with room, board and washing. The section man receiving $1.25 per day and paying $13 to $15 per month for room and board had a net wage somewhat higher than the best farm laborer, while his work, though perhaps harder, was less irksome and his hours of labor fewer than those of the farm hand.

Today, farm labor of good quality commands $30 to $35 per month, with the customary board, lodging and washing; while the section man's 15 cents per hour would, were he any longer an American, be subject to a charge of not less than $20 per month for board and lodging; that is, the section man's net pay has decreased, while the farm hand receives double what he formerly did, more than double the section man's net pay now. Manifestly the "five Dagoes" must continue to "bate the Irishman out of his job" and the farms continue to absorb the best of the common labor unless something radical is done by the railroads.

The question then becomes "What is practicable?" since present earnings do not warrant any large increase in expenses.

The cost of labor is intimately connected with the increased cost of the American standard of living. A little consideration of the elements of this increased cost may point the way to secure better laborers, without materially increasing the rate of pay.

When men live in the towns, as most section men do now, the increased population of the towns has resulted in the landlords taking an increased slice of their earnings. The opportunity for dealing directly with the producer of milk, butter, eggs, meat and farm produce generally is almost a thing of the past, so that the middleman takes an increased "rake-off" without asking the laborer's consent. The associations of local retail dealers find means of eliminating the competition that once existed in the sale of merchandise, and the laborer is powerless to prevent paying exorbitant profits on his small purchases, while if he has a growing family there is practically no method whereby the rest of the family may contribute anything to their own support.

Now, there is no apparent reason why the section men should live in the towns, and in taking them out of the towns lies the opportunity of the railroads to secure better laborers as a permanent asset with probably a large reduction in maintenance expense. To do this the railroads should exercise to some extent the prerogatives of "royalty," which is the compliment of "loyalty." Royalty properly understood means leadership and care for the dependent. The handling of labor as a commodity to be purchased in the cheapest market will never result in securing good or loyal laborers. The reduction of laborers to a common level of pay, and that the lowest, results inevitably in a common level of service and that the poorest. If anyone doubts this conclusion let him watch the work of the men now employed in common labor on the railroads.

Wherever the railroads are located in agricultural territory, getting the section men out of the towns should be an easy matter.

Sufficient capital should be set aside to purchase land at every alternate division between two sections, so that each permanent employe could secure, say, ten acres. On each of these holdings a good house of permanent construction, and necessary outbuildings to make an inviting home, should be erected. The homes should then be rented to the right kind of laborers at just enough to cover interest and maintenance cost, conditioned upon the agreement to work upon the section when required. In addition to this, the men should be promptly paid semi-monthly. The results would be: First, the cost of rent would be no greater than for a house of poor quality with a single small lot in town, while the ground properly utilized would provide employment for each member of the family, and for the laborer himself in his spare time, whereby the cash outlay for food would be reduced to almost nothing; second, by combining purchasing power the cost of clothing and other necessities would be very materially reduced; third, the six to twelve families in each section men's colony would form a fine nucleus for a country school, church and for social activities among the farmers, and tend to establish better relations between the railroads and the farmers who are their neighbors and ultimate patrons, and this is no small consideration, for there is no estimating the loss to the railroads from the fact that there has been no social tie between them and the people whom they serve; fourth, the very best class of common labor could be had upon these terms, and when secured could be relied upon to remain permanently, and the young men growing up in the families so located would form a desirable future supply; fifth, the better location being given as a reward to the best men would serve to stimulate ambition, and tend to overcome the deadening influence of a level rate of pay.

In addition to this "return to the soil," the men might be given the advantage of the purchasing departments of the railroads for buying staple supplies, and the benefit of expert instruction in the technical part of their work, and advice as to the best means of utilizing the land.

All this could be done by the railroads with practically no expense whatever, simply extending to the men the advantage the companies possess of borrowing money and purchasing supplies in large quantities, thereby securing the lowest rate and price obtainable.

Such consideration by the companies would make the men feel that they were a real part of the organization, not mere vendors of a commodity (labor), and would most surely result in securing a full supply of those better laborers of whom the railroads today stand so much in need, and in restoring that feeling of loyalty which has been so utterly lost.

The Southern Pacific has surveys under way with a view to continuing double tracking above Colfax during the present year. The first stretch of double track will probably be from Colfax to Capron.

The San Luis Valley has been incorporated in Colorado, with $1,000,000, and headquarters at Denver, to build from a connection with the Denver & Rio Grande at Alamosa, Colo., northwest to Monte Vista, thence north to Saguache, about 60 miles. J. M. Herbert is a director.

HOW WE TREAT LABORERS.

D. O'Hern, Roadmaster.

I issue instructions to all foremen to increase their force to a certain number of men. I let them choose their own men. If they can pick up local men in their town or city, they get a better class of laborers. If they cannot I fill their gangs. I get men for them from the labor agencies.

As to extra gangs, we get these from labor agencies. We first tell them the wages they are to receive and how long the job will last, then we fix up bunk cars in good shape and station them where they can get good water, and close to the street car or steam railway line so they can get their provisions out from Chicago daily. This will hold your men.

If you want to increase the amount of work done daily you must educate your men. Put a certain number of men spiking, tamping, on tongs and so forth; keep your men with the same tools daily, if possible, in steel gang. Do not change your men too often. If you do they will become dissatisfied, as most men take pride in becoming experts at certain kinds of work.

The class of men we have to contend with are mostly foreign born and cannot speak the English language, but you can make the best kind of track men out of them by educating them to understand our work and by fair treatment.

I do not allow any foreman to mistreat his men or use abusive language. If you cannot get a good day's work out of a man without abusing him, give him a time check and let him go. By using bad language and driving, you do not get the good will of the men, and consequently they will kill more time on you when you are not watching them. One kind word is worth a dozen harsh ones, but at the same time you must use strict discipline and give them to understand that you are the foreman.

If you have bunk cars as we do, I tell the foreman to visit the camp on Sundays and see that cars are kept clean, show the men how to make themselves comfortable, and if the cars need any repairs see to it that they are repaired at once. It will please the men to know that their foreman is not too proud to visit them, and they will go to work with a light heart and do you better work.

LABOR EFFICIENCY IN TRACK MAINTENANCE.

R. P. Black, Engineer Maintenance of Way.

Labor efficiency can be had only with a good organization and a well established esprit-de-corps. The organization must have first, a head or general who is fully competent to direct and place labor where it can be applied to the best advantage; second, foremen who are competent to control men and each foreman must have complete knowledge of the task that he and his laborers have been directed to do; third, laborers, experienced, efficient, sober and industrious in their line. These men should be paid a wage scale sufficient and increasing in proportion to their knowledge. Personal character in the selection of the men for the executive positions should be given due consideration.

Such an organization having been formed, can only be worked successfully by maintaining strict discipline and providing rewards of merit for all concerned. In this manner only, is it possible to get the best results from the man, whether he be the foreman or the laborer. Man, no matter how high a wage he may be paid, unless he has the incentive to work to something higher or better (including positions of authority) will not increase his production, but on the other hand will become lazy and laggard. "The survival of the fittest" with just reward should be the motto of the labor organization.

For increasing the efficiency of the section foreman, higher rates should be paid to the more important section foremen. The foreman of the yard section, on account of there being more men as a rule on his gang, and more switch and emergency work required, should be paid say $10.00 more salary per month. The foreman of the extra gang, for the same reasons, should be paid the same rate as yard foremen. The foreman for the yards and extra gangs should be selected from the more efficient road section foreman when vacancies occur. The yard section foreman at the division point headquarters, should be the one selected to fill a general foreman's or supervisor's position, for he is in closer touch with headquarters, being able to become more familiar with general conditions, and he usually gets good training in sending out and handling material from the store room or division material stock yard.

On each section gang of any importance there should be one laborer paid say 10 per cent more than the other laborers. The man picked for this pay should be one of the old employees who shows promise of becoming a good section foreman. By the above method there is a regular line of promotion in the track department for a laborer of ambition to work for. The pay increases in proportion to the responsibility from the laborer's position on the section to head man on gang, to section foreman, to extra and yard gang foreman, to general foreman and to a supervisor's position. Should a supervisor show warranted ability he should be eligible to a higher position.

PROCURING AND HANDLING TRACK LABOR.

C. C. Henkel.

Labor conditions with regard to track maintenance work vary greatly in different sections of the United States. In the east the majority of track laborers are Italians, Poles and Hungarians coming next in importance. In the south a great many Negroes are employed, while in the southwest and the far west Mexicans and Japanese are in the majority. In the sparsely settled west the labor agent is a necessity, while around the large cities of the east this is not so much the case. In view of these widely differing conditions I will confine myself to personal observations in the territory adjacent to New York City.

The road on which I am employed touches nearly every large city and town in northern New Jersey, and by a little effort on the part of the foreman he can usually secure all the men he requires in such places as Paterson, Newark, Passaic, Garfield, Rutherford and Jersey City.

Until recently we were subject to the mercy of a labor agent who had things very much his own way. He had a contract with the railroad by which he could charge every man $1.75 per month for lodging them in shanties which he erected on the right-of-way, regardless of whether the man was living in his own home nearby or not. When the labor agent could not get men the foremen were politely informed that they could go out and hire any men they could get. This system was demoralizing in the extreme, and was a source of annoyance both to the foreman and to the men, to say nothing of the indirect loss to the company. When the gangs were reduced in the fall we were compelled to let the local men go, keeping only the labor agent's men. This state of affairs made it difficult for the foreman to get good results, as he was unable to reward a good man by giving him steady work; and on the other hand, the labor agent's men became very independent and insolent. On one occasion I was politely informed on giving an order, which was not pleasing to the gang, that the labor agent would get me fired and the gang would get some one in my place who would let them have their own way. How-

ever, this is now a thing of the past, as the arrangement with the new agent provides that he is only called upon to furnish men when the foreman is unable to obtain them locally.

I have said that in the section in which I work we have no difficulty in securing all the men we require, but I must qualify this in one respect. It has sometimes happened that due to financial exigencies we have been unable to start our season's work until the first of July. By this time local contractors have picked up a large part of the labor available. The question of wages is not of great importance. We pay $1.50 per day, while the contractors in this vicinity pay $1.75 and $2.00. In spite of this I often have men leave jobs at the higher rate to come to work for me because they are sure of getting their money, can work Saturday afternoons, and one or two Sundays a month, and will be paid for rainy days.

I pursue about the same methods in handling extra gangs as I do with my section gang, with the exception that extra gangs are not paid for time lost on account of rain. I do not believe much in the argument which one so often hears, that section gangs are given to soldiering and that one cannot accomplish as much with such gangs as with a regularly organized extra gang. The only objection to doing heavy work by increasing the size of the section gangs is that the section foreman is called away more or less to look after the light repairs and general routine of the section. This can be remedied, however, by furnishing him with an assistant capable of looking after that work.

I find that treating men fairly and with consideration is the best possible means of keeping them satisfied and holding them on the job. In spite of the old saw about driving mules and profanity, I have seen a great many mules that would work along all day without any admonition of that character. It is my opinion that the more yelling and cursing a foreman indulges in, the less work he gets out of his men. An occasional show of temper on the part of the boss, however, tends to put ginger into the gang.

The expedient of having a mixed gang is a great aid in getting the work done in many cases, and saves a good deal of wear and tear on the foreman's nerves. I had a job for a short time sorting and loading switch timbers and divided my gang into two parts, composed of ten Poles and ten Italians, respectively, with very good results. After I had marked all the ties I wished loaded I could go and sit on top of one of the piles. The spirit of rivalry intensified by racial antagonism did the rest. Neither gang could bear to see the others get their car loaded first.

In my experience the Poles are the best men where great strength or heavy lifting is required, such as is necessary in rail gangs, while the Italians are more painstaking and make the best tampers.

In this vicinity it is not necessary for the foreman to speak the language of his men, although it is advantageous if he can do so. Neither is it necessary to employ an interpreter. He is usually more troublesome than the labor agent. It is unusual here to get a gang of men together without finding five or six among them who can speak English, and who have worked on the track before. The green man soon catches on by observing his more experienced mates.

The responsibility for obtaining good men and securing efficiency in doing track work rests largely with the foreman. Like the trainmaster, the dispatcher, the conductor or the shop foreman, the chief clerk or, in fact, any one in the railroad service who has to handle men, he must be a live wire. He must not continue to do a job in an inefficient way just because that is the way it has always been done. Above all things, he must study his men and use diplomacy in handling them.

COMPANY LABOR BUREAUS.

L. W. Strayer.

Labor is a commodity, its price depends upon the supply and demand, and unfortunately the demand for track and construction laborers is seasonal so that the rate per day fluctuates accordingly. The tendency of foreigners to roam from one place to another and the usual unsettled condition in this country, makes foreigners preferable to Americans with family connections, for construction work.

During the recent years of industrial progress, heavy demand for laborers has resulted in the influx of many foreigners and consequently the establishment of labor-agencies, primarily to provide the "new-comer" with a job among his country-men for a small fee. At the present time most all of our extra gangs and section men are procured through these channels. The labor agencies became exploiters of men in search of work and only after some rigidly enforced labor laws were enacted and put into effect, did they resume a more legitimate business. In fact, the labor fee extracted is proportional to the number of men required, and in the early spring a large fee is charged; these men after paying a premium for an opportunity to earn wages are not much concerned as to the amount or quality of the labor returned, the job and its results being a secondary consideration. We seldom get good results from such men.

Foreigners being unaccustomed to the language, ways and customs of this country, were at a loss many times to make their wants known or settle any differences amicably. This want brought into existence a business agent between the labor agent and the foreman, the "interpreter." While in a sense his appearance was a benefit, his attitude generally is a detriment to a gang and a hindrance to the foreman; he usually instructs his men to take orders only from him, the men feigning ignorance when addressed directly; his idea of the amount of labor to constitute a day's work for a man or men varies widely from that of a good conscientious foreman. The labor agent who has sent the gang out keeps in touch with them through the interpreter, and is advised what is required of them. Frequently the foreman is one of the kind who makes the company's interest his, and is determined to produce results. The interpreter will make complaint to the labor agent and the local officials. The latter nearly always support the foreman but cannot materially alter conditions. The labor agent makes a plea to the company's representative for a change in foreman or some better conditions, generally closing his grievances with a causal threat to call his men off and send them to another job, incidentally collecting another fee. In this way it is a difficult task to keep a gang satisfied, for it is almost impossible to "weed out" the dissenters or get rid of an undesirable interpreter without the gang quitting with him, and a large part of our work must be done under just such conditions.

Not infrequently a gang is sent to some distant point, and on arrival they are not properly provided for, either in the way of a suitable place to live, food and water are not obtainable, or sanitary conditions are not what they should be. The poorest cars and dwellings are patched up in a hurry for camp purposes and are not fitted out with stoves or the cars with adequate locks, etc. The tendency is to slight the track laborer in every way and give him only the very least possible so that it is hardly more than reasonable to expect that we receive his efforts in the same proportion. The characteristics of each nationality vary widely; these are points that must be considered in dealing with foreigners. When they realize that they

are being treated fairly and squarely by the company, through a foreman who knows his business and one that cannot be trifled with, they will turn in and do the work and use their energies in a useful direction. Rivalry can be stimulated between gangs of the same and different nationalities doing the same kind of work, by comparison of the kind and amount of work performed by the various gangs. This means makes for better success than any effort to drive men. In fact when labor is scarce, the driving method cannot be resorted to without losing the men.

During the past year or two it has been difficult to get foreigners to take places on sections, especially where only four or six were required to fill out a gang. They prefer to work in large gangs at a lower rate of pay under an interpreter where they can shirk their duty and have the favorites of the interpreter act as camp watchman, water boys, cook, etc. It is agreed universally that a gang of a hundred men are more unwieldy to handle doing most any kind of track work, under present conditions. Where large gangs are sent out, they are assured a season's work, transportation to and from the job, food supplies shipped free from the dealer of their own nationality, free camp cars or dwellings and coal, so that they can work for a lower rate than a few can at some isolated town on a section gang. There are many good gangs of trackmen which measure up well; they are the first to be taken on and the last to be furloughed, working year after year for the same company, and often for the same division.

In any case, it is far more desirable to recruit ones forces from the locality in which they are to be used than to import them. Men of the former type are more liable to have the company's interest at heart; they are settled and steady, and in turn they spend their money in the same district, being an asset to the community both in person and in efforts. In rural districts, mountainous countries and in some agricultural districts, the section forces are of American birth, and after all these are the best trackmen. Each year the supply decreases, the recruiting of extra gangs of Americans is almost out of the question, due to the fluctuations of forces, low rate of pay, and better opportunities in commercial and industrial works. The railroads are inclined to let the foreign trackmen shift for themselves. For some that may be all right, and this is especially true of Italians; those who are more Americanized in their mode of living demand the ordinary necessities; these must be placed within their reach in some manner. The "hobo" and "negro" were among the first to require commissaries. Nearly always they are penniless and not inclined to go to work unless they can see some food within reach. Commissary companies have taken the contract for feeding men at a given rate per meal, provided deductions for the same are made from the pay-rolls in their favor. The commissary companies are furnished the necessary buildings and equipment by the railroads and are attached to most of the large camps. This method has proved satisfactory and is now being pursued to advantage.

In order to obtain maximum results from the foreign element it is necessary to have each do the sort of work for which they are best fitted; for instance, Austrians and central Europeans are conceded to be best for rail laying, work train gangs, and such labor where much physical strength is required. Italians are most efficient on raising track, shovel tamping, and grading, where strength is not the paramount qualification; negroes do the best pick tamping on stone, due to the unison with which they can be made to work. Greeks are among the less desirable for track work, preferably used on dressing up track, clearing right of way, etc., and the lighter kinds of labor. It is seldom productive of harmony to mix nationalities or have Americans working among foreigners.

It would seem that a saving could be effected and the efficiency of labor increased by the organization of a centralized labor bureau under the direction of the proper operating and maintenance officials. Such a bureau of labor would have absolute jurisdiction over all such matters. A commissioner at the head of the organization with four or five inspectors working around over the territory which the railroad traverses, could work locally and in conjunction with the division officials on the ground. It would be the duties of the inspector to hire men for the district in which he has his headquarters, and, as far as possible, supply that particular locality with sufficient men. He would inspect the camps and make himself familiar with the local conditions. These inspectors would personally see that each man sent out was physically capable of doing the work he was being sent out to do and that no "sight-seers" would use the transportation illegally after being booked by the inspector. Such a position would require a man who has had experience with such a class of labor, preferably a former supervisor or roadmaster. He would work directly under the commissioner of labor who would be responsible to the management for the entire labor situation on that particular road, thus having a standard rate of pay, hours, accommodations, length of job, deductions, housing conditions, employment of watchmen and interpreters. He would also conduct business with the labor agents or immigration companies for the individual personally, or through his authorized assistants. Such a bureau would hire men in gangs, or separately, sending them to the nearest point at which they are to work. When a gang has finished or forces are reduced these same men might be available for some other division or construction work, so that a transfer might easily be accomplished, thus saving the many labor fees of agencies, and the company would have the benefit of seasoned and experienced laborers, better satisfied if an occasional shift of location were made.

The abuse of free transportation to the place of work is an evil that needs correction. Labor agents take advantage of this by calling on the proper officials for transportation which is furnished them in the form of a pass good for fifty or a hundred men. This in turn is exhibited to those inquiring for a job, who are signed up regularly, the fee extracted or agreed to be deducted from the pay roll so that by train time possibly twenty or thirty men are available. Some of these are willing to go to work and have executed the contract in good faith; others pay a few dollars and are en route the "mother country." Or "joy riders" will pay the labor fee presumably to go to work. On arrival they make some excuse and look for another charitable "lift." Thus for a fee or a few dollars they get half way across the continent. Under the present system it is almost impossible to cope with this abuse, but a labor bureau would have jurisdiction over such matter, follow up and prosecute several offenders and thus make some examples. And as soon as this class of labor finds out that the law takes hold of them, they will desist from such practice.

EFFECT OF HIGHER TRACK STANDARDS ON LABOR.

P. H. Hamilton, Extra Gang Foreman.

We work Americans (negroes and white men) and some foreigners on our sections; but most of our section men are Americans, natives of the localities in which they work. The hiring of men for sections is left entirely to the section foremen and they hire whom they please. Most of the men on extra gangs are foreigners and these men are al-

ways furnished to the extra gang foreman by the roadmaster through labor agencies. We find that the foreigners dislike to work on sections because it is necessary for them to divide up into small gangs. I have seen large gangs of foreigners stay idle all winter rather than divide up into bunches of three or four.

While Americans are the best men for track work it is becoming hard to get them for sections on account of the minimum wages paid; and it is hard to get them for extra gangs as they dislike "batching." The policy of maintaining only small extra gangs is doing away with the boarding outfits as the labor and supply agencies do not like to put out boarding cars with small gangs. With the foreigner it is just the opposite. He will not go on a gang where there are boarding cars, if he can keep from it, because he can board himself in his own way much cheaper. In fact, he will live too cheaply, to the detriment of his constitution.

In organizing an extra gang we should bear in mind these four things: the kind of foremen needed, the nature of the work, the class of men, and the tools and equipment. The foreman should be selected according to the class of men to be handled, as some foremen can handle one class of men to a better advantage than others. He should be an organizer of men; and he should be able to line his work out a day or more ahead of time. He should train each man to do a certain part of the work and should be able to keep him steadily employed at that one thing. Sometimes, the best men in the gang feel that they are being discriminated against and become dissatisfied. That is, one man is found to be an expert spiker and is kept continuously busy at that line of work, while some other men are kept busy at less arduous work on account of their inability. I believe that a good spiker or a good jackman should receive a few cents more per day than the other men as an incentive. The foreman should be firm with his men, but he should also be friendly to all without approaching familiarity. He should have a definite understanding with each man as to what he expects of him. The day of the "slave driver" is past. It is possible that the driver could turn out more work than the milder foreman, if he could keep men, but men will not now stand for that sort. A kind word from the foreman to his men is appreciated by them the same as the foreman appreciates a kind word from the roadmaster. One great trouble with extra gangs is the tendency of the foreman toward slighting the work, to make a showing. The roadmaster should always pick the foreman who will do the work thoroughly and leave work that will "stay up." The foreman should not be remiss in his work.

The American is the best all around trackman, but the present wage is no inducement, for he can obtain much more remunerative work. I believe that the negro is the best man for a steel gang. He is strong, intelligent, and has the stamina for heavy work. Of the foreigners I consider the Mexican the best all around track man. The Italian and the Bulgarian are both good for heavy work.

We hear a great deal of the old time track men, and the old time foremen, and how the present day gangs could not compete with them. This is possible to a certain extent, for the foreigners are not as capable as the Irishmen and American laborers. But I believe that our foremen are, as an average, far superior to the foremen of any previous time. It is true that they are not able to show up the work that some of the predecessors could a decade ago; but the conditions are all against them. They have more trains to protect against, heavier material to handle, more exacting standards for different kinds of work; and generally, an inferior class of labor. Take, for instance, the method of relaying rail. It used to be the custom to couple the rails together before putting them in the track, placing them on the ends of the ties in strings of ten or more with the joints bolted up tight. The moment that a train was by the spikes were pulled and the old rail thrown out of track and the string of new rails lined in. Nowadays the rails are laid in the track rail by rail. The former was the cheaper method, but we cannot gainsay that the latter is the better method. In times not far back four men with tongs could handle a rail where it now takes twelve. I remember a story of a forgetful Swede on a western road. The foreman had to take out a broken rail and he sent the Swede after a piece to replace it. The Swede walked down to the rail pile and brought back four or five rails and threw them down in front of the foreman, saying, "Vell, boss, I haf forgot what length you want, so I haf bring you an arm full. Peek out what you want." 'Tis not this way nowadays.

In times past the foreman only placed six switch plates when he now places twenty-one. He punched holes in the iron rails instead of boring them. He coupled his rails together with fish plates, which are much easier applied than the continuous or Weber joints. Thus the constant evolution of construction and maintenance of way standards has done much toward increasing the cost of track work.

While the wages of railroad employes as a whole have been materially increased during the recent years the trackmen have been overlooked. They are today the poorest paid class of common laborers; and many of them feel that they are being discriminated against. We understand that the managers of the railroads are not favorably inclined toward any increase in wages unless they can see a corresponding increase in efficiency. To increase efficiency we must create competition among the men. Make them feel that their positions are worth striving for. The foreman should be allowed to pay enough to enable him to employ strong, able-bodied American men; men with stamina and courage, capable of doing heavy work; men who are ambitious and who will turn out good work. The present wages paid generally throughout the country for track labor will not permit of this. The foremen get a great many of broken down old men, and young boys; or else physical and moral degenerates, who are incompetent. Whenever he gets a good man some contracting company or some farmer who has his eye "peeled" for good men hires him away at a slightly higher rate of pay.

While we cannot mathematically illustrate it, I believe that an increase in track men's wages would produce an increase in efficiency doubly commensurate. For it would make satisfied men; men who would put forth their best efforts and accomplish much in a day's work. It would be and incentive for young men with ambition and ability to work on track; and the inferior man would have to put forth much better efforts or get off. There would be competition and the foreman could discharge a drone knowing that he could get another man to put in his place. He could keep his good men indefinitely and could drill his men into an effective organization.

BETTER LABOR AVAILABLE AT HIGHER WAGES.

Allen McGill.

The labor employed on roads in this section, "Rio Grande Valley," is entirely Mexican and most of the men are looking for the work which is the most remunerative. In the different seasons men will leave the sections to obtain better wages in the fields, picking cotton, making hay, cutting wood, harvesting rice, etc. This labor is generally very fair but it is unreliable for section work.

The only visible labor supply then is to be had from the larger towns along the road. Generally the terminus is the only place to obtain labor. This labor consists of men pre-

viously employed on other sections along the line who have quit for a rest, a class of men who are supported part of the time by degenerate women, saloon bums and "tin-horn" gamblers. A laborer in the gang is given a return pass for himself and as many men as are wanted, and he proceeds to enlist as many men as are needed from the ranks of the above-mentioned class. The result is about 15 per cent fair labor; the balance is almost worthless.

The rate of wages is low, but the latter class is not worth the small wages paid.

We make no special inducements to hold the latter kind of labor. Like nearly all foreign labor it is not appreciative of good treatment. Get what work you can out of them, which is about one-third as much as a good Irishman, or Irish-American, can perform, and let them go when they get too slow and trifling.

Where a man stays from 10 to 12 months on a section, working faithfully, the company generally gives him a pass for himself and family on recommendation of the foreman.

It is not difficult to get a fair day's work from the good class of men mentioned, but as I said before, their labor is below the standard, as to quantity and quality, as compared to native labor.

To increase the amount of work accomplished we adopt a competitive system. In widening embankments, cutting grass, tamping raised track out of face, etc., let each man take a rail that corresponds to his number and work that rail only, going ahead when finished.

This can be practiced when tightening bolts and, in fact, most any kind of track work, and will result in the laggards either working more diligently or dropping out altogether.

Driving men has played out in this country. Treating regular section men, who follow this work, with consideration pays, but it is wasted on the bums and transients who only want to make a dollar or so to guzzle beer on.

It is of greatest importance to have your men work with some system. Let two men work together at all times tamping the same tie, spiking, and carrying ties; in fact, doing everything together that requires the labor of two men.

They get used to each other and each knows what he is going to do and what the other man is going to do, thus facilitating the work and getting better results. I would suggest the following for obtaining better laborers and for increasing the efficiency of track forces: A decidedly higher standard of wages will procure men who are efficient and who take an interest in their work. It will cause good men of other vocations to seek track work and eliminate the drones and clock and pay car watchers, who now infest so many lines of railway in this country, and perhaps bring back to American railways American and Irish and German laborers who are not afraid of work and who know how to do work without forever being told.

TRACK LABORERS, AS AFFECTING THE FUTURE SUPPLY OF SECTION FOREMEN.

T. B. Whitney, Track Supervisor.

The lowest paid railway employe in the United States is the trackman, and yet he receives a greater compensation than some of the railway employes of France and twice as much as those in Italy.

While the cost of living of a railway employe in the United States is less than 50 per cent higher than that of a corresponding employe in foreign countries, his remuneration averages over twice as great under these conditions. With the present arrangement which we have adopted on the N. Y. & W. R. R. we should have no trouble to obtain foremen for the future.

Each season we select one young man who can read and write the English language correctly, and put him in the gang as first man, paying him a few cents more per hour as an inducement to remain with the company.

If the section is an isolated one, for which we are unable to get a suitable young man locally, we transfer him from some other section. In this way he learns the condition of different points on the line, and this gives the company a chance to have more young men in line for promotion as well.

We should have no trouble in getting young men to learn track work. A farmer's son makes the best and as a general rule he will stay, as the hours of work are shorter than on the farm and the pay better.

A supervisor must keep in close touch with his men, as he is the only one who can really tell who the man is and who is doing the work on the section, and by knowing the men he creates a feeling of satisfaction among them that will enable him to obtain more efficient service.

I can pick a foreman from 50 per cent of my gangs at this time under the above arrangement and consider this as good as can be expected, knowing that not every man would be capable of handling men even if he understood the manner of maintaining track safely.

THE SECTION BOSS.*

The super and roadmaster have me both be th' throat; the G. M. is another who's got me goat; the agint ahlways has some kind av a kick; the opyraytor's that smart he makes me sick; the farmers howl 'cause I don't cut th' weeds —sure, it's sivinty minds a section-boss needs.

What wit' officers droppin' butterflies from th' trains, divvil th' wonder it is that I have anny brains.

But lowerin' cinters or raisin' up j'ints, reparin' grade crossin's or linin' switch p'ints; belave me—there's wan thing I don't have to do—is take anny slack from wan av me crew.

Sure, I'm out all day in th' cold and hate, prancin' up and down on me blistered fate; freezin' or sweatin' and cussin' th' b'ys, linin' up track or puttin' in ties; tampin' in ballast or diggin' a ditch; shoulderin' fills or layin' a switch; slopin' a cut or rasin' a grade; pullin' up rails or gettin' 'em laid; cleanin' a culvert or whitewashin' fences, small wonder it is I'm not out av me senses; but—wan thing sure—smoke this in your pipes—I'll stand no raymarks from wan av me snipes.

"Sit th' car on!" Sure, they move with a jump. Puttin' me foot on the brake, I give th' word, "Pump!" With mesilf standin' proud as they yank her along, I kape me eye peeled fer annything wrong.

Then it's, "Sit th' car off! Git out th' jack! Stand by the pinch-bars! There's a kink in th' track!

"J'int ahead! Quarter back! Yo-he-ho! Cinter back! All togither Right! Let her go!"

If thim fakes and th' roadmaster would moind their own jobs, I'm th' bucko can manage me own gang av slobs. Fer ye kin take it from me—I just want to say—the lad that talks back to me gets his pay.

Fer I'm th' boss av me section—th' king av thim all. Jist watch thim hustle whin they hear me bawl. The trackwalker shakes like he was goin' to die whin I take a step t'ord him and flutter me eye.

Th' rist av th' gang just hump their backs, whilst I squint me eye up and down th' tracks.

But wit' all th' trouble it's moighty fine to be th' wan that is kapin' their time.

Let the super wire and th' roadmaster cuss and the agint and opyraytor kick up a fuss; but whin I'm alone wit' me gang—sure he must be a bird. if wan av me shlaves dares to give me a word.

*By Walton Burroughs in the Railroad Man's Magazine.

RAIL RAVELINGS.

Dear Son:—

Well, boy, if they keep on giving you more work I will feel like getting back into the harness (I am not a dead one yet), and asking you for the position of assistant. Perhaps if I did you could get back at me for some of the "callings" I used to hand you when you were learning to handle a gang and do track work. A few of these I distinctly remember. For instance: I came along one day where you were working a gang and told you a farmer could do better railroading than you were doing. It made you pretty wrathy and you told me to get a farmer to do it. I turned and walked away to conceal a laugh and I never caught you doing work in the same manner again.

Another time we were installing some double slip switches under traffic in connection with an interlocking plant. You were assistant foreman. The foreman was a good man, but things did not exactly suit me sometimes when I came upon the work. One day I called your attention rather emphatically to some part of the work that wasn't moving just right. You asked why I didn't "jump" on the foreman instead of you, and I told you I wasn't particularly interested in making a track man of the foreman. And after a while it seemed to dawn on you that I was taking this method to thoroughly impress on you some of the important things in track work. A foreman once said to me, "The only thing that kept me from quitting you once when you jacked me up was that I remembered how you used to do with your own boys to make trackmen of them."

Because you had new track to keep up you figured on a "snap," did you? Well, that goes to show that you still have something to learn, for with the settling of new road-bed, causing track to get out of surface and line, gullies washing out in embankments, and ditches filling up in the new cuts, grade settling at the ends of bridges and culverts, and highway and farm crossings to care for until they are firmly settled, the foreman on a new section has anything but a "snap." In fact, there are no snaps in the track department. Your mile of old track is not so bad if it only requires 6 ties to 30 feet. I have frequently put in from 8 to 10 ties to the panel on main line. Your manner of distributing your material was good. I would put the ties in right, properly spiking and tamping each one, filling in and dressing up to keep out the water in case of rain, and would report the actual number put in each day. If this did not suit I would tell the roadmaster I would put them in on paper just as cheaply as he wanted me to, no matter how many of them were lying in the ditch when they were all in on paper. Also that I could and would put them in the track just as quickly and cheaply as any other foreman who would put them in right. A majority of ties are thrown in the track, lightly tamped, if at all, and in many cases left for days without spiking, in order to make the report look right. This in the long run increases the cost of maintenance, as it is sure to make rough track. It is a serious mistake to half do work in order to make a paper showing. The fault for poor work in renewing ties lies entirely with the officials, who generally are men with no practical experience in maintenance and who do not know how much the actual cost of renewing ties should be. Reporting ties put in for less than actual cost, which is the prevailing practice, may fool stockholders and help some high salaried officials hold their positions, but it will not lessen the cost of maintenance.

Should you be called on to take charge of a surfacing gang I do not think you would have any difficulty in making good. Organization is the key to the situation. In the first place be sure your assistant is a good track raiser and that he will make a good surface. Also select a "bubble man" who will watch the level board carefully. Put 6 men with each jack, 3 jackmen, 2 tampers, 1 "swamper." Where the raise is high or for some reason the conditions are such as to require considerable shoveling to the tampers, it is economical to use 2 swampers. Use two spot boards so the spot board man can always have one ready; this he does by carrying one board ahead and setting it while the other one is being used. When practical, I organize tampers the same as spikers on new track. That is, have them tamp in gangs of 8 men to a tie. If you have three gangs each gang tamps every third tie, if four gangs every fourth, and so on. In every gang there are some poor tampers and by this method the good and poor tamping is so distributed as to cause the track to settle uniformly. Watch the tamping closely and also the raising, and be sure you have a good top on your rail. Don't let any one "call" you because of rough track. Keep your lining up every day. If possible have a small "sniping" crew a day or two behind the big gang to pick up any low or rough places which may develop. The "king snipe" with this crew should be a first-class man. There are many such men who are unable to handle a large gang.

Yes, I remember the gang you speak of, although I had nothing to do with the work. You asked what I would have done when the interpreter called off the gang because he was discharged. I would have paid them off on the spot, just as I did two gangs under similar circumstances on my last position, and if they objected to it at headquarters I would not have "backed down gracefully," but would have called for my time.

Run the job while you are in charge if you last only half a day. I agree with you as to interpreters discouraging a gang. The most of them are a hindrance to the work. They tell the men to "take it easy" in order to stand in with them to get the graft. They take no interest in the work and care nothing at all about it. But as long as they are tolerated by the officials, foremen will have to put up with them. Dad.

Dear Dad:—

Just received your letter, and they haven't shoved any more work on me, as far as the section is concerned; they have sent me out with an extra gang, as I thought they would. I left my straw boss in charge of putting in ties, and also to look after the section. I am starting the surfacing right on my own section, and am working east. We have the gang partially organized, but your suggestions will come in nicely.

No, I don't think I would care to get back at you for the "callings" I used to get, because I needed them. Don't ever expect to be so that some criticism could not be made of my work, or so that I couldn't improve it myself. It seems to me that every good track laborer has ideas from which good pointers can be obtained, and I never want to get so "stuck up" that I can't see a better idea no matter from whom it comes. I like to get my gang so well organized that I can put in some time scheming and planning the work to increase the amount, and at the same time to make the work as easy as possible for the men. A man can use a lot of judgment in handling a large gang, and this is probably true more especially of track laying, putting in switches, etc. It is a problem to keep your men close together, and be able to move the whole gang when a move is necessary. If you leave a part of the gang behind, it will always take them longer to finish the work than if the foreman were there. If the gang gets scattered it is pretty hard to oversee the work—harder for the foreman, easier for the men to slight something important.

When raising the track, I am going to use two jacks, and always move them ahead, raising both joints and centers to the spot board, as we used to do on newly laid track. I think this will work out all right, as the rails are in pretty good shape, and joints are not battered down. This not only gives an actual saving of a half of the distance your jacks have to travel, but gives the men less chance to kill time if they are so inclined.

Your point about dressing up track when renewing ties is a good one, and just as good a point in surfacing track. Here is a chance for a foreman to so estimate his work that he can dress up the track each night with the exception of the run-off. That is not quite as necessary in a dry climate as it is

where rains are liable to occur any night. And if it does rain, and the track isn't dressed up, and what is a good deal worse, if it isn't center tamped, the nice top you have put on your track will go to pieces in a night.

It is all right to have your sniping gang behind the extra gang, but I am not going to do as some foremen do—leave the track in such poor shape that the whole thing will have to be resurfaced. If the lift is exceptionally high and the grade has not settled, I don't think it pays to do the tamping quite so solidly. But if the raise is low, and the sub-grade good, the extra gang should not leave a great amount of work for the regular section gangs.

Your suggestion about using two spot boards is good, and I think another good thing is to have three spot board blocks; one to carry yourself, one for the jack men, and one for the level man. Then if it is necessary to knock down a joint or center a little, after the jacks are let off, the jack men can run ahead, carrying the extra block along, and set the jack. While they are doing that, the level or hammer man is knocking down the high place. By the time the men have the jacks set the level man is ahead and ready to level up the joint.

MANUFACTURER'S BRANDS ON STEEL RAILS.

P. M. La Bach, Asst. Engr., C., R. I. & P. Ry.

The earliest steel rails made, as a rule, have the manufacturer's name, initials or trade mark rolled on them in raised letters. To this in time was added the month and year also, in raised characters. When chemical specifications were added to the requirements the heat number was placed on the rail by the use of a die. To this has been added a letter of the alphabet indicating the position of the rail in the ingot, also stamped or countersunk into the rail web.

All of the railways which keep statistics of rail failures require that all these brands or markings be reported with other data for each failed rail. The importance of getting these letters and figures correctly is not always apparent to the man on the ground, but when a compiler goes to work he is frequently puzzled by a heterogeneous collection of initials and dates which are nothing more than a rusty guess. Those who have had occasion to compare the failed rails with the reports find that mistakes are common. The rail should be cleaned with a brush or piece of metal until the reporter has no doubts as to the exact letters and figures. If there are duplicate figures, as sometimes happens, these should be reported and the facts stated so that the person handling the report will know the exact situation.

When a rail report is turned in, the inspection report made at the mill at the time the rail is rolled is dug out of the files and a search made for the chemical analysis of the heat number of the month and year given on the report. It not infrequently turns out that there is no report of this number for the month or perhaps the year. Then the report must be returned for correction and usually is found to be correct, on second trial. All three, the month, year and heat number must be given to avoid confusion as heat numbers are numerous at the mills and nothing can be told from the number alone.

There does not seem to be so much trouble with the letter indicating the position of the rail in the ingot. These letters start with A for the top of the ingot. The next rail is marked B and so on until the metal is exhausted. Generally speaking there are only four to eight rails to an ingot, depending on the weight of rail and ingot. We may expect to find 100-lb. rails lettered from A to F and 80-lb. rails marked from A to H. However it is not uncommon to find O and even V given as initials.

The marker's name or sometimes trade mark is always given. This frequently takes the form of P. B. S. Co., or other combination of letters. Errors are sometimes made in these and the writer has found several cases in which he was unable to discover what rolling mill did the work. To aid in identifying these companies the attached list was made from a variety of sources. It is intended to include manufacturers rolling rail heavier than 50 pounds per yard. It makes no pretense of being complete and any additions would be thankfully received.

Steel Companies Rolling Heavy Section Steel Rail, and Year of First Rolling of Same.

	Name of Company—	Year Steel First Rolled
1.	Albany & Rensselaer Iron & Steel Co., Troy, N. Y.	1865
2.	Pennsylvania Steel Co., Steelton, Penna.	1867
3.	Freedom Iron & Steel Works, Freedom Iron Co., Freedom, Penna.	1868
4.	Cleveland Rolling Mill Co. (Newburg Rolling Mill) Cleveland, O.	1868
5.	Cambria Iron & Steel Works, Cambria Iron Co., Johnstown, Penna. (Now Cambria Steel Co.)	1871
6.	Union Iron & Steel Co., Chicago, Ill.	1871
7.	North Chicago Rolling Mill Co., Chicago, Ill.	1872
8.	Joliet Steel Co., Joliet Steel Works, Joliet, Ill. (No rail since 1899)	1873
9.	Bethlehem Iron Co., Bethlehem, Pa.	1873
10.	Edgar Thomson Steel Works, Carnegie Bros. & Co., Braddock, Pa.	1875
11.	Lackawanna Iron & Coal Co., Scranton, Pa. See No. 30.	1875
12.	St. Louis Ore & Steel Co., Vulcan Steel Co., St. Louis, Mo.	1876
13.	Colorado Coal & Iron Co., Minnequa Rolling Mills, Pueblo, Colo.	1882
14.	Pittsburg Bessemer Steel Co. (Carnegie) Duquesne, Penna.	1881
15.	Milwaukee Iron Co., Milwaukee, Wis.	1868
16.	Scranton Steel Co., Scranton, Penna.	1883
17.	Troy Steel & Iron Co., Troy, N. Y.	1886
18.	Worcester Steel & Iron Co., Worcester, Mass.	1884
19.	Maryland Steel Co., Sparrows Point, Md.	
20.	Homestead Steel Works, Carnegie Steel Co.	1881
21.	Lorain Steel Co., Lorain, Ohio	
22.	Illinois Steel Co., Chicago, Ill. Made up of Nos. 7, 8, 15, 6.	1890
23.	Western Steel Works, St. Louis, Mo.	
24.	Tennessee Coal, Iron & Railway Co., Birmingham, Ala.	
32.	National Steel Co., Main Office, New York City.	
25.	Pittsburg Steel Castings Co., Pittsburg, Pa.	1881
36.	Trenton Iron Co., Cooper & Hewitt, Trenton, N. J.	
26.	Duquesne Steel Co., Pittsburg, Pa.	
27.	Springfield Iron & Steel Co., Springfield, Ill.	
28.	Algoma Steel Co., Sault Ste Marie, Canada	
29.	Dominion Iron & Steel Co., Sydney, N. S., Canada	
30.	Lackawanna Steel Co., Buffalo, N. Y. No. 11 Moved.	
31.	Southern Iron Co., Nashville, Tenn.	1891
32.	National Steel Co., main office, New York City	
33.	Alleghany Bessemer Steel Co., Duquesne, Penna.	1889
34.	John Brown & Co., Sheffield, England, Sheffield-Atlas Steel Co	
35.	Colorado Fuel & Iron Co., Pueblo, Colo. See No. 13.	
36.	Trenton Iron Co., Cooper E. Hewitt, Trenton, N. J.	

LIFE OF WOODEN AND IRON TIES.

This subject was discussed recently in a Bulletin of the International Railway Congress, from which the following extracts are taken:

One of the most important advances made in technical matters is the recognition that in determining the value of any technical system, one of the most important considerations is its economy. Naturally we strive for perfection in our designs. But even the most ingenious design is to be condemned, if it does not prove economically satisfactory; there is no justification for taking the technical point of view alone and declaring a design satisfactory, if it is not so from the economic point of view as well. Hence, it is very satisfactory if a question of very great economic importance, such as the life of superstructure materials and especially of railway ties, is brought nearer to solution, as has been done by the work of Mr. Biedermann, permanent way and traffic inspector in Germany. The conclusions given herein were based solely on the average life of ties, on long stretches of track.

Mr. Biedermann draws the conclusion that the present creosoted pinewood tie, when hard broken stone is used as ballast, will have a life of eighteen to twenty years, and that the life of iron ties will hardly exceed this. On the other hand, the new iron ribbed tie should have a life of thirty-four years, taking into consideration its higher price, and the more expensive fastenings and ballast required, if it is to be economically equal to a wooden tie having a life even of only fifteen years. According to Mr. Biedermann, this decides the economic contest in favor of the creosoted pinewood tie.

If we assume that the life of iron ties as compared with that of wooden ties should prove on careful investigation (which would involve other points which it would take too long to discuss here) to be considerably more favorable than as determined by Mr. Biedermann, yet the difference as calculated by him is so great, that in comparing the two kinds of ties, the scale seems to turn strongly in favor of wooden ties. Hence, it would be very desirable that the administrations using iron ties on the large scale should give particulars of their experience, which would probably elucidate the reasons why the ties were renewed and show what final conclusions can be drawn.

Where Erie's waves roll limp and clear,
When cool September's breezes blow,
And "83" is the remedy,
Just put me off at Buffalo.

With men from East, from South, from West,
From where the Northern blizzards blow,
We mingle on one common ground;
Yes, I am going to Buffalo.

It's there we'll grasp the friendly hand,
Our loyalty and friendship show,
And when we to our homes return,
We'll long remember Buffalo.

—Andrew M. Clough.

CREOSOTE IN TREATED PILES AFTER LONG SERVICE.*

The piles described herein were of pine (probably longleaf), and had been in the teredo-infested waters of the Gulf of Mexico for about 30 years. One was perfectly sound, but the other had been attacked, particularly at the water line. The analyses were made to determine whether the difference in their durability could be accounted for by a difference in the amount or character of creosote in the wood.

The piles had been treated by the old Bethell process, but no treating records are available, nor is it known where the creosote was obtained.

Pile No. 1.—This pile, said to have been in service 30 years, was perfectly preserved, showing no indications of decay nor of attack by teredo. The portion above water was badly checked. It was received in three sections: Section 1, taken from above the water line; section 2, taken from near the mud line; section 3, taken from the lower end of the pile in the mud.

Radial Views of Three Sections from Pile No. 1.

Pile No. 2.—This pile, which had been creosoted and placed in the Biloxi Bay trestle in 1879, and removed in July, 1910, had been attacked by teredo, especially near the water line. Only a portion of the whole pole, approximately 6 feet long, extending 3 feet above and 3 feet below the water line, was received. This was considered as three sections: Section 1, above the water line; section 2, at the water line; section 3, below the water line.

Figure 1, shows radial views of the three sections of pile No. 1. It brings out clearly the depth of penetration of the creosote. Figure 2, shows three cross sections of pile No. 2. The work of the teredo, it will be noted, is in the treated wood.

In the case of pile No. 2 the amount of creosote in the entire cross section at the water line (sec. 2) is only about half of that in either of the other two sections; but when calculated for the treated portion only, it is nearly the same. This difference is due to the loss of a great portion of the creosoted wood in this section, making the proportion of untreated to treated wood much higher than in the other two cases. The portion of the treated area in the three sections of this pile as received at the laboratory was: Section 1, 61 per cent treated; section 2, 35 per cent treated; section 3, 64 per cent treated.

To determine the quality of the creosote, the oil was extracted from a large volume of chips by chloroform. The resulting extract was then freed from rosin by the use of sodium carbonate, and from chloroform by distillation. The residual creosote was then analyzed according to the method described in Forest Service Circulars 112 and 191.

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*From a bulletin of the U. S. Forest Service.

None of the sections contained an appreciable amount of light oils. The creosote from section 3 of pile No. 1, in which presumably less change in the character of the oil had occurred, contained 2.5 per cent of oils distilling below 205°. The same creosote contained over 40 per cent of naphthalene oils (distilling between 205° and 255° C.). The other two sections of the same pile also contained considerable quantities of naphthalene.

The distillation of the creosote from pile No. 2 gave a very small percentage of distillate (below 305° C.) and a large amount of residue. The oil from section 3 (below the water line) of this pile, which yielded the largest amount of distillate, contained only 12.6 per cent of oils volatile below 255° C., and little or no naphthalene.

The change in composition of the creosote from sections 1 and 2 is shown more fully in Table 2, in which the fractional distillation is computed on the basis of percentage of what is assumed to be the original oil.

Temperature.	Percentage weight of distillate.		
	Section 3.	Section 2.	Section 1.
°C.			
225	30.8	15.8	1.5
245	11.0	13.1	6.1
275	6.4	6.2	15.0
320	19.0	18.0	20.5
Residue.	32.3	33.4	30.8

Fractional Distillation of Creosote from Pile No. 1, in Per Cent of Assumed Original Oil.

Table 2 shows that the loss of creosote in that portion of the pile in the water as compared with the loss from the portion buried in the mud was confined to the fraction distilling below 225° C. and that the loss from the portion in the air occurred only in the fractions below 245° C. The small excess of distillate between 225° and 245° C. in the creosote from section 2 over that for the same fraction from section 3 may be accounted for by the effect which the absence of some of the lower boiling constituents at the lower stages of the distillation produce upon the fractionation of the distillate. The same explanation will account for part of the relatively large excess in the distillate between 245° and 275° C. of the oil from section 3.

Allowing for the losses as computed above, sections 1 and 2 of this pile originally had 6.1 and 17.6 pounds, respectively, of creosote per cubic foot of the treated portions. Section 2 thus agrees very well with section 3 (see Table 1). But the figure for section 1 is so much at variance with the figures for sections 2 and 3 that this section probably lost creosote in such a manner as to leave the composition of the residual oil unchanged, as by "bleeding." The original volume of oil must therefore have been more than 35 per cent greater than the present.

Pile No.	Section No.	Amount of creosote found per cubic foot.	
		Entire cross section.	Treated portion only.
		Pounds.	*Pounds.*
1	1	2.6	4.5
1	2	10.7	15.3
1	3	12.0	17.1
2	1	10.4	17.0
2	2	5.8	16.5
2	3	11.5	17.9

Amount of Creosote Found in Piles.

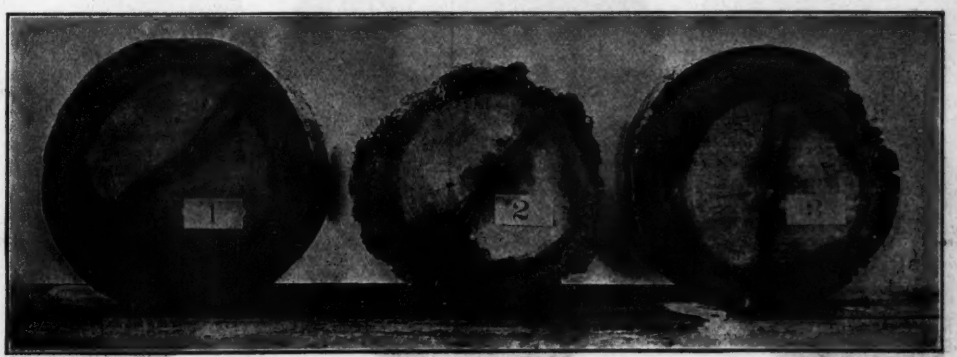
Similar changes occurred in pile No. 2, except that in this case section 2, which is the portion at the water line, changed most. This may be due to its position, where it was subject to the influences both of sun and water; and also to the fact that, being riddled by the teredo, more opportunity was afforded for leaching of the creosote.

Practically no light oils (oils distilling below 205° C.) were found in the piles after their long period of service. If originally present, they were lost by volatilization and leaching.

The creosote in the pile which was perfectly preserved contained originally at least 40 per cent of naphthalene fractions, a large portion of which remained in the wood. The creosote in the pile, which was less perfectly preserved, contained little or no naphthalene.

The pitchy matter, which on distillation formed the residue above 320° C., is seemingly of an inert character and little objectionable to the teredo. A heavy treatment with creosote consisting largely of this material did not entirely save the pile from attack.

Loss of oil from that portion of the pile in the water, in the case of creosote in pile No. 1, which is a pure coal-tar creosote, apparently occurred only in the fraction distilling below 225° C.



Cross Sections of Pile No. 2.

With The Manufacturers

THE TRACK SUPPLY ASSOCIATION.

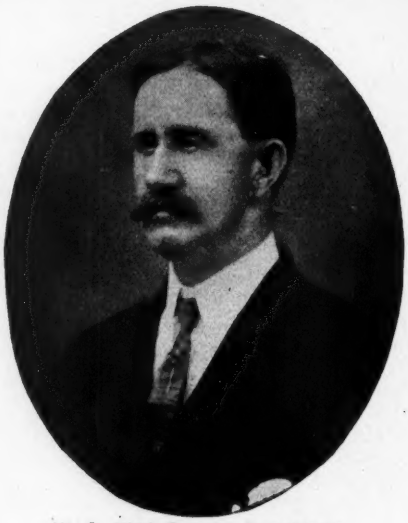
By W. C. Kidd.

"What is the Track Supply Association"? was a question asked me some time ago in Chicago.

When the Roadmasters' Association held its twenty-eighth Annual Convention at Chicago, every supply firm which was represented felt disappointed because someone had not notified it of the meeting sooner. A few of the boys who were on the alert and looking after their masters' business, had selected some of the choicest rooms in the hotel, which enabled them to shoot off their fire-works to great advantage. Some had desirable locations and some had not, but notwithstanding that fact, before the convention was over there appeared to be general satisfaction. However, three or four of the head lights thought an organization of some kind was necessary. The association was formed, and we can thank the Rail Joint Co., or at least Mr. Holloway who is one of its officers, for the name which everyone seems to be proud of.

When the convention assembled at St. Louis, in 1911, through the untiring efforts of the secretary and treasurer of the Track Supply Association, every manufacturing concern which was fortunate enough to be there was well taken care of regarding space for its exhibit. The officers of the Association at that time were: William Goldie, president; Major Holloway, of Kansas City, vice-president; H. C. Holloway, secretary and treasurer, and the "Ramapo Kidd," was on the executive committee in company with his Scotch friend from Kalamazoo (McKinnon). The convention of the Roadmasters was a most successful one, and from a manufacturers' standpoint, I have every reason to believe that every exhibitor felt that he had received his money's worth, though none of the officers who were first elected seemed anxious to be re-elected, except possibly "that Kid from Ramapo;" and even he would not consent unless he had as an associate a rail anchor "to hold him down."

It would be a pleasure to give the names of the officers of the association as it now stands, if it were not for an incident that happened at Buffalo while the committee was alloting spaces for the exhibitors at Hotel Statler, in connection with the Thirtieth Annual Convention of the Road-Masters' & Maintenance of Way Association, which proved to the writer the excessive modesty of every officer of the Association with the exception of one. I guess that every



W. C. Kidd, Ramapo Iron Works.
President, Track Supply Association.

exhibitor knows that F. A. Preston, who represents the P. & M. Co., is secretary and treasurer and Mr. J. H. Weston of the Lackawanna Steel Co., is vice-president. These officers, together with a young gentleman whose home is sometimes in Toledo and at other times in Steelton, Pa., better known as Walter Allen of the Pennsylvania Steel Co., and T. E. Vaughn, of the Vaughn Rail Support Co., compose the executive committee. The last named did not exhibit any modesty because he was not present. The high flyer, or the most modest one of the five officers of the Association is not "O. U." Kid, but W. C. Kidd, of the Ramapo Iron Works, Hillburn, N. Y.

To be a little serious, it might be well to state right here that when the Thirtieth Annual Convention of the Roadmasters' and Maintenance of Way Association adjourns on September 13th, it will be found that every exhibitor who has spent his time and exerted some of his vitality to show his particular line of railroad appliances, can safely say to himself that he has attended the most successful convention, the most interesting and the most profitable that it has ever been his pleasure to attend.

Each member of The Track Supply Association has given

A. H. Weston, Lackawanna Steel Co.,
Vice-President.

F. A. Preston, P. & M. Co.,
Secretary and Treasurer.

W. H. Allen, Pennsylvania Steel Co.,
Member Executive Committee.

Officers of the Track Supply Association.

considerable of his time during the past year to make this affair successful, and everybody knows that it costs money to attend Executive Committee meetings; but, if the officers of the Association do not receive any more appreciation than I saw exhibited at Chicago last March, I do not think that we shall wear many medals when we leave Buffalo.

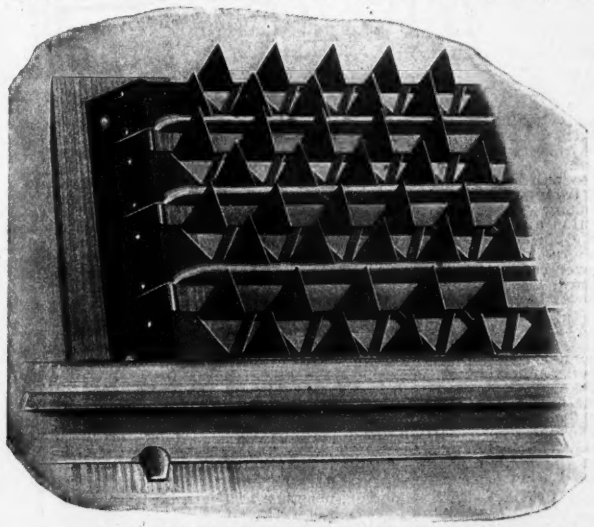
At this point I wish to prophesy that if there are less than five hundred roadmasters present, it will be because trains have stopped running to Buffalo, and it is with a fervent hope that every manufacturer that markets anything which is used in the maintenance of way department has not missed this opportunity or waited until it was too late to find desirable space for his exhibit.

If there is any fault to find with the above lines, I shall commend all the knockers to communicate with Smiling John McKinnon, of Kalamazoo, Mich.

CATTLE GUARD OF NEW DESIGN.

Each year the railways pay out thousands of dollars in damages for cattle killed on the right-of-way, and many of these accidents are caused by poorly designed or defective cattle guards. In addition to the expense in settling such damage claims, there is great danger of derailments with, possibly, resultant loss of lives of passengers and destruction of rolling stock.

The illustration, herewith, shows a type of metal surface guard which certainly appears capable of keeping all animals from passing from a road onto the right-of-way. This type is one of a number manufactured by the National Surface Guard Co., the Rookery, Chicago, which claims that all "National" guards are made of the best material obtainable, and built by skilled workmen. These guards are



National Surface Guard No. 10.

quickly and easily installed and also easily removed when making track repairs.

They need no extra length ties or other special preparation for installation. All of the designs have interchangeable sections and are so constructed as to be protected against displacement by dragging chain hooks or brake beams. Fillers for double track in all designs are made to order.

The National No. 10 is formed and punched from heavy plates, mounted on and securely riveted to V-shaped cross sections. The teeth are 2¾ inches and 3 inches apart in all directions. Open hearth steel or rust resisting metals are used in its manufacture.

Since the injurious effect of brine drippings has been shown to be serious, many railways have taken steps to prevent brine from dripping on the right of way. These preventative measures remove the only great objection to metal guards.

Industrial Notes

WATER SOFTENING.

Recent developments seem to indicate that there is to be a renewal of the subject of water softening on the railways, and it is probable that a number of water softening plants will be ordered. The Chicago, Milwaukee & St. Paul is now in the market for a large plant, and is reported to be considering a second plant. Several other railways are reported to be considering different methods and systems of water softening.

The Denver & Rio Grande is reported to be in the market for several water softening plants.

Darwin R. James, Jr., has been made president of the Pyrene Manufacturing Co., New York, succeeding P. L. Wilbur, resigned. Edward A. Clapp has been made secretary of this company, succeeding Otto Kelsey, resigned.

B. M. Osbun has resigned his position as president of the Boss Nut Co., Chicago, to become president and treasurer of the Auto Refrigeration Co., of the same city. J. T. Benedict, vice-president of the Boss Co., has been made president, succeeding Mr. Osbun.

The Davenport Locomotive Works has opened an office in the First National Bank Building, Cincinnati, Ohio.

Wilbert W. Lamb, of Cincinnati, Ohio, has invented a weed burning machine for burning weeds and grass on railways. A company with a paid-up capital of $300,000 has been organized to manufacture and lease this machine to railroads. The machine is mounted on a railroad car and is composed of burners which feed gasoline to seven large tubes, consuming 200 gallons of fuel an hour while the car is running eight miles an hour, a speed which, it is said, leaves the rails and ties unheated, although every living thing coming beneath the fire dies.

The Kentucky Southwestern Electric Railway, Light & Power Company, Paducah, Ky., is in the market for 200 standard gauge cattle guards.

The Washington Railway & Electric Company of Washington, D. C., has ordered from the Westinghouse Electric & Manufacturing Company five quadruple equipments of No. 306 motors with K-40-A control.

The Westinghouse Electric & Manufacturing Company has received an order from the White River Construction Co., of Joplin, Mo., for four 2,667 Kva., O. I. W. C. single phase, 25 cycle, 66,000/3,300 volt transformers and three 1,000 Kva., 33,000/2,300 volt, 66,000/3,300 volt transformers; also six 650 Kva., O. I. S. C. single phase 25 cycle, 66,000/6,600 volt transformers; six 250 Kva., 33,000/2,300 volt transformers. Also one 1,250 Kva., frequency changer set consisting of 1,540 h. p., 25 cycle, synchronous motor and 1,250 Kva., 60 cycle, generator operating at 2,300 volts both sides.

Messrs. Corrigan & Murray have the contract to lay the track on the Kansas City, Clay County & St. Joseph Ry. and have arranged for the use of a Hurley track laying machine to lay the track. The machine has been shipped and track laying will be started in a few days.

The Canada Foundry Co., Toronto, Ont., has awarded the contract for motors and switchboards in the new pumping station at Hamilton, to the Canadian General Electric Co., Petersborough, Ont.

The Union Switch & Signal Co., is completing the erection of several additions to its plant at Swissvale, Pa., including a new office building at a cost of several hundred thousand dollars.

Recent Engineering and Maintenance of Way Patents

REROUTING FROG.

1,035,957. C. H. Gambill, Nashville, Tenn.

A rerailing frog comprising a truncated V-shaped casting inclined to the horizontal and having upon its upper face marginal guard ribs extending from the base upwardly toward the truncated end of the V, and also provided a wheel flange receiving groove; and upon the opposite side at an oblique angle to the guard rib with a similar wheel flange receiving groove merging into the first groove at the apex, the two flange receiving grooves merging at a point just inside the rail.

RAIL JOINT.

1,035,857. Mike Chulick, Marianna, Pa.

The combination with a rail chair having side flanges, rails having the ends thereof confronting upon the chair and the webs of the rails provided with openings, of splice bars bracing the webs of the rails and having lateral flanges engaged by the flanges of the chair, knobs carried by the ends of one of the splice bars, a knob carried by one end of the other splice bar, a notched lug carried by the opposite end of the bar, a link arranged in one of the openings of the web of one rail and engaging the knobs of the splice bars, and an apertured and slotted member arranged in the opening of the other rail and engaging the knob and notched lug of the splice bars at the opposite ends from the first mentioned knobs.

METALLIC RAILROAD TIE.

1,036,210—Allison Moffet, Galeton, Pa.

A metallic railroad tie having a longitudinal base plate provided with longitudinally disposed and parallel flanges, the rail bearing edges of each flange being provided with a rail flange receiving recess of greater length than the rail base and one side of which recess is engaged by the rail base, a plate of substantially the same width as the rail base having its ends seated within a recess of each flange and forming a means to retain the flanges against spreading.

FERROCONCRETE RAILWAY TIE.

1,036,234—Albert Henry, Paris, France.

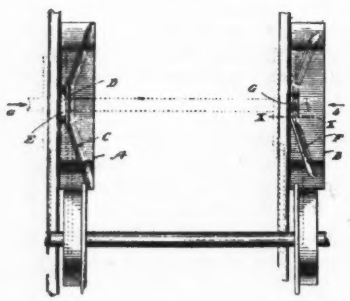
A reinforced concrete tie comprising a concrete member having a longitudinal slot in its central portion, hollow metal rail seatings embedded in the concrete and extending above its surface to form resilient rail supports, and metal reinforcing wires or rods arranged in two groups each running through the tie member to reinforce the concrete on both sides of the slot, the wires extending around the bases of both seatings.

MAIL CRANE.

1,036,246—J. M. Haigh, Woodbine, Ia.

A mail crane comprising a standard, an upper arm pivoted to the standard to rock in a vertical plane, a lower arm also pivoted to the standard to rock in the vertical plane, and devices on the arms

1,035,875



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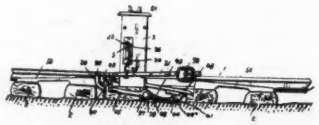

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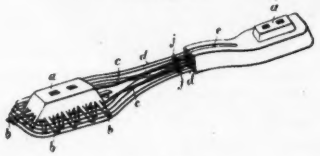

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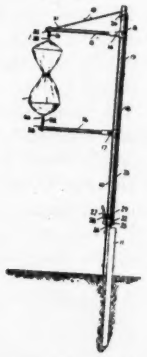

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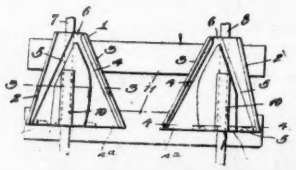

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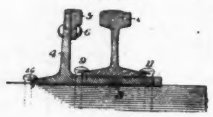


REROUTING DEVICE.

1,035,875—A. E. Hancock, N. Chillicothe, Ill.

A rerailing means comprising an inner and an outer block, each lying adjacent one of the rails and each having a part uprising from its upper surface to a position above the top of the rail and extending in an angling direction toward the rail, one of the parts having a depression at its terminus nearest the rail, there being a depression in the other block adjacent the terminus of the part lying nearest the rail.

CATTLE GUARD.

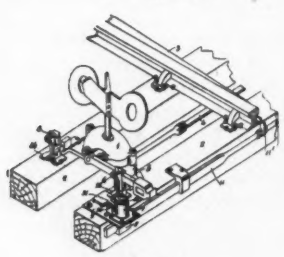
1,036,154—G. T. Senn, Ottawa, Ont.

A railway cattle guard comprising a box casing, a gate frame comprising a number of cross pieces pivoted to each other intermediate of their length and at their extremities in toggle arrangement, the extremities of the inner section being pivotally secured in the box casing, an end bar pivotally secured to the extremities of the outer of toggle sections, an operating bar pivotally secured at one end thereof in the box casing and having a longitudinal slot extending through the greater portion of its length and a pin extending from one of the toggle joint sections through the slot in the operating bar.

CONCRETE RAILWAY TIE.

A reinforced concrete railroad tie having in combination a base of uniform surface and width on its under side, upright sections thereon under the rail tapering toward the top upon which the rail is seated, the sections being connected between the rail-seats by a vertical rib extending across between the rails and buttressed on the outside by similar vertical triangular ribs between the ends of the base and rail-seats, the upper surface of such rail-bearing sections having a depressed space for receiving a cushion block, the inside and outside ends of such space being approximately circular in form.

1,036,410



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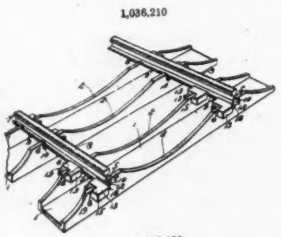

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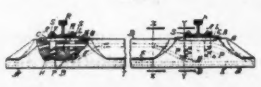
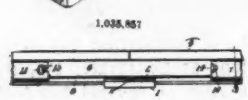


1,035,857



for engaging a mail bag, a flexible element connected at one end with the upper arm, a pulley on the standard and over which the flexible element runs, a pull rod suspended on the opposite free end of the flexible element, a guide on the standard for guiding the pull rod, the pull rod terminating in an eye at its lower end, a transverse pin mounted to slide in the standard and adapted to engage the eye on the pull rod when the eye is in the lower position and the upper arm is raised, a strap on the standard above the pin, and a vertically disposed lever fulcrumed between its ends on the strap, the mentioned pin having the end adjacent to the lever connected with the lower end of the lever, the upper end of the lever being free and disposed in the path of movement of the lower bag-holding arm, to be struck by the arm.

GUARD RAIL.

1,036,305—Andrew Morrison, Pittsburgh, Pa.

A guard rail comprising a base member having an integral guard portion rising therefrom, the member having a flat main rail-supporting portion of uniform thickness extending inwardly from the base of the guard rail to a point beyond the outer edge of the main rail, the guard portion being set away from the main rail sufficiently to provide clearance between the base of the main rail and the guard portion for an adjustable fastening for the main rail, the fastening directly engaging the vertical edge of the base of the main rail and holding it in alinement.

AUTOMATIC SAFETY SWITCH LOCK.

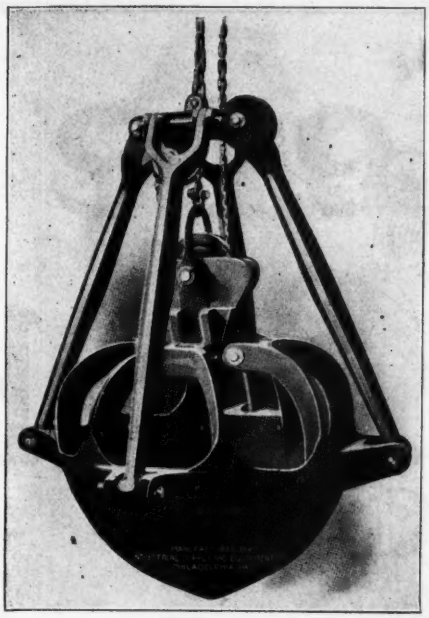
1,036,410—F. C. Anderson, assignor to The American Valve & Meter Co.

An automatic safety switch lock comprising an interlocking bar, a slotted dog adapted to engage and lock the interlocking bar from endwise movement, a housing in which the dog is mounted to prevent the interlocking bar from movement, a lifting arm mounted on the stem of the dog, and a pivoted foot bearing trip lever adapted to operate the lifting arm at one end and to operate and control the keeper of a switch stand latch with its foot bearing portion at its other end.

The Bald Eagle Valley branch of the Tyrone division, Pennsylvania, R. R., is undergoing some necessary changes involving the revision of grades, extension of passing sidings, construction of lapsidings, and building a new line over four miles long from Mount Eagle to Howard Rolling Mill, which includes extensive changes to public roads.

The Rio Grande Valley Traction has been incorporated with $300,000 capital, to build from El Paso, Tex., southeast to Socorro, about 15 miles. M. M. Phinney, Boston, Mass., is one of the directors.

The St. Louis, Brownsville & Mexico expects to build a number of additional sidings in the near future.



Rickards Cast Steel Orange Peel Buckets

The Bucket for Hard Service

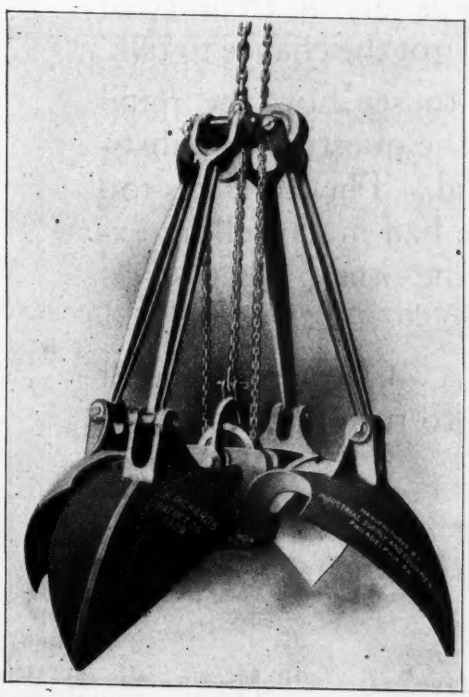
Rickards Orange Peel Buckets are constructed with four curved triangular cast steel blades, and when closed form a tight semi-spherical bowl, which holds the excavated material.

Rickards Bucket parts are interchangeable and are numbered and lettered. Reference to the number of the bucket being all that is necessary in ordering any part.

The Center Block is made of cast steel and fitted to carry and allow the bucket to hang central at all times.

All buckets are fitted with chain wheels, as this construction has been found more desirable. Buckets to be operated by wire rope will be furnished if so ordered.

The Rickards Orange Peel has been so designed that three sizes of blades can be used on the same crown rigging. That is, you can buy say a 1 yard Bucket and also buy ¾ yard and 1¼ yard blades for same rigging.



The Industrial Supply And Equipment Co.

407 Sansom Street, Philadelphia

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Kalamazoo Railway Supply Co., Kalamazoo, Mich.
Wyoming Shovel Works, Wyoming, Pa.

Transfer Tables.
Nichols, Geo. P., & Bro., Chicago.

Trolley Brackets.
Electric Ry. & Equip. Co., Cincinnati, O.

Turntable Tractors.
Nichols, Geo. P., & Bro., Chicago.

Turntables.
Nichols, Geo. P., & Bro., Chicago.
Philadelphia Turntable Co., Philadelphia.

Valve Grease, Graphite.
Dixon, Joseph, Crucible Co., Jersey City, N. J.

Varnishes and Japans.
Glidden Varnish Co., Cleveland, O.

Velocipede Cars.
Kalamazoo Railway Supply Co., Kalamazoo, Mich.

Washers.
Hubbard & Co., Pittsburg, Pa.
Coes Wrench Co., Worcester, Mass.
Dixon, Joseph, Crucible Co., Jersey City, N. J.

Water Chemists.
Lord, Geo. W., & Co., Philadelphia, Pa.

Water Columns.
Kalamazoo Railway Supply Co., Kalamazoo, Mich.

Water Coolers.
Gray, Peter, & Sons, Boston.

Water Filters.
Pittsburgh Filter Mfg. Co., Pittsburg, Pa.

Water Purifiers.
Lord, Geo. W., & Co., Philadelphia, Pa.

Water Purifying Chemists.
Lord, Geo. W., & Co., Philadelphia, Pa.

Water Softeners.
American Water Softener Co., Pittsburg, Pa.
Booth, L. M., Co., Chicago.
Wm. Graver Tank Works, E. Chicago, Ind.
Lord, Geo. W., & Co., Pittsburg, Pa.
Pittsburgh Filter Mfg. Co., Pittsburg, Pa.

Wedges.
Hubbard & Co., Pittsburg, Pa.

Wheelbarrows.
Kalamazoo Railway Supply Co., Kalamazoo, Mich.

Wires.
Central Electric Co., Chicago.

Wire Tapes and Cords.
Central Electric Co., Chicago.

Wooden Water Pipe and Conduit.
Michigan Pipe Co., Bay City, Mich.

Wrecking Frogs.
Johnson Wrecking Frog Co., Cleveland, O.

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